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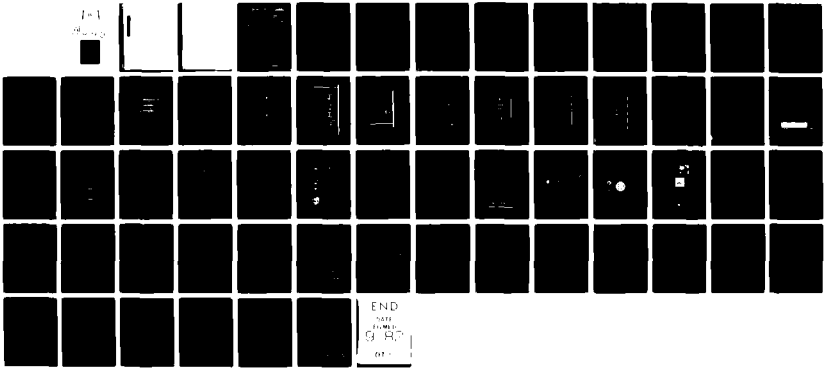

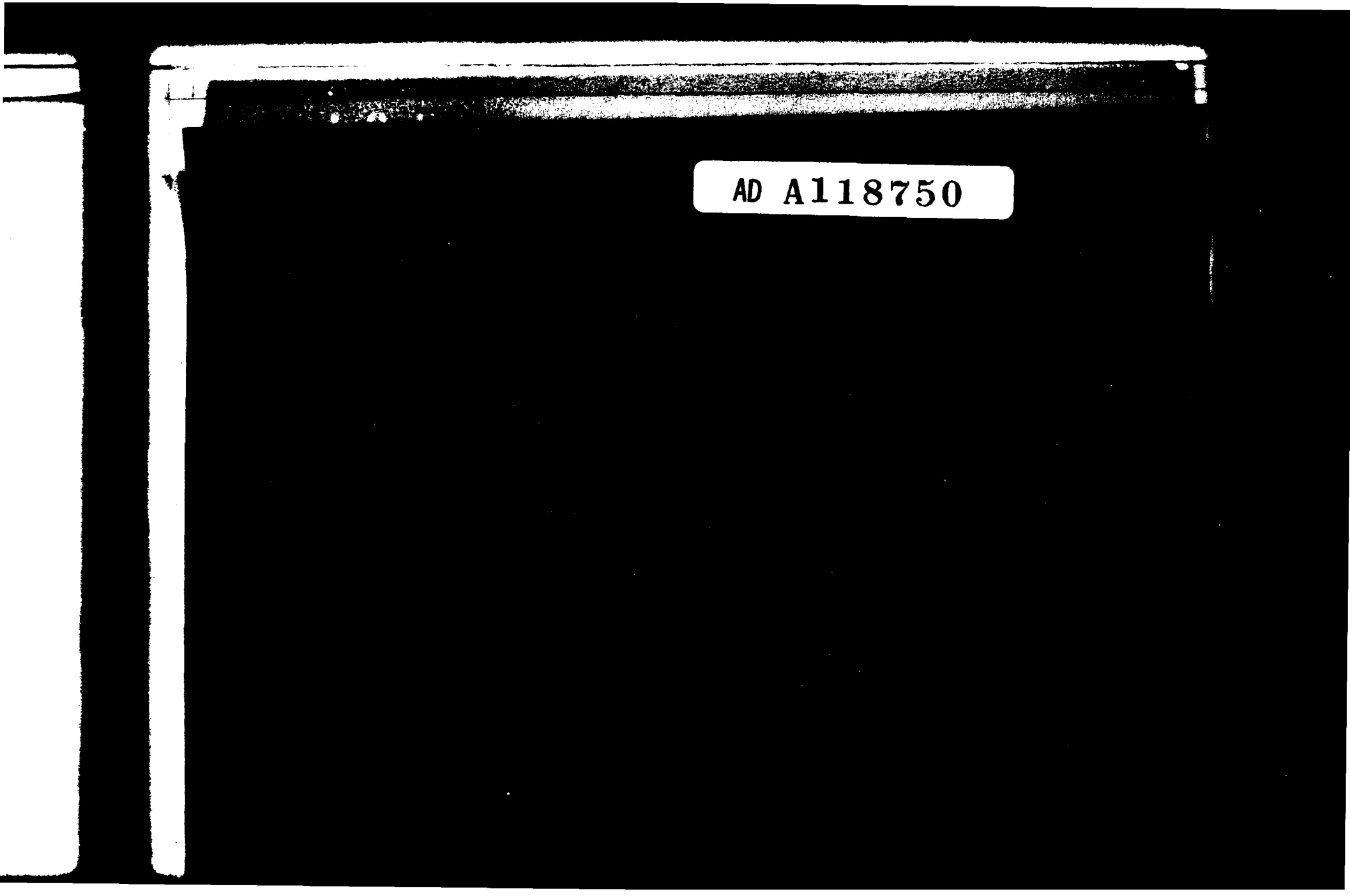

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Air Intercept Controller (AIC) Prototype Training System Configuration

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This report delineates the design criteria and human engineering principles and practices to be applied in the design and general arrangements of the ACE Prototype Training System. The specifics for site preparation, detailed floor plans and environmental requirements will be developed in the Prototype Facilities Report to follow.

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FOREWORD

This is the Prototype Configuration Report for the prototype Air Intercept Controller Training System. The purpose of this report is to delineate the design criteria and human engineering principles and practices to be applied in the system design. After presenting the general arrangement, more detail is presented for the Instructor Station and Student Station, and maintainability and human factors considerations are discussed. In the arrangement of the equipments which comprise the principal stations of the system, and the arrangement of displays and controls for the components which make up the principal stations, the prevailing considerations are configuration of a functional, dynamic and effective training system. To this end, configuration of the system overall, and its components, has balanced realism in replication of the Naval Tactical Data System (NTDS), effective and efficient training of students, effective and efficient management of training by supervisory personnel, and relisble operation of the system while still providing ready access by maintenance personnel.

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SECTION I

INTRODUCTION

This report provides a description of the configuration of the Air Controller Exerciser (ACE), a prototype Air Intercept Controller (AIC) training system, as it will be assembled for test and evaluation. There are two physical partitions of the system: (1) the combined computer suite with instructor station and (2) the student station. These partitions are connected by electronic cable.

The objectives in the configuration of the computer suite and instructor station included minimum thermal effect on equipment; compactness to facilitate onsite placement and minimize interface cabling, while insuring accessibility for assembly and connections; operator convenience; maintenance access; and overall placement to enhance logical system understanding and operation by the instructor-operator. Thermal effect was considered in both vertical and adjacent positioning of components and activation of blowers during power-up; flexibility offered by the cabinet rack and individual blowers within equipments facilitated placement. The availability of false flooring onsite insures ready access during installation of cables and making connections. Panels and controls are labeled for identification. The documentation and media cabinet provides ready access to reference documentation for operators and maintenance personnel, with built-in racks for disk packs, diskette trays, pullout frames and documentation pivots, etc. Later discussions of individual components will specify maintenance accesses, but in general access is by sliding racks, front access, or easy access for removal of the component or its cover; disk-based diagnostics and built-in test features facilitate isolation and identification during maintenance analysis. Instructors will find sequencing of start-up and operating procedures to be easily understood and efficient.

The foregoing considerations also were applied to configuration of the student station relative to installation and maintenance, but the primary emphasis was on facilitating the student learning process. Realism in the Training Enhancement Console (TEC) contributes to a dynamic learning situation which will maximize carry over and transfer to the fleet environment and the family of Naval Tactical Data System (NTDS) consoles. Effectiveness of the audiovisual system will be greatly improved by the videodisc enhancement, but the videodisc monitor and cathode-ray tube (CRT) terminal represent the artificial, school environment of the system. For this reason, the angular positioning was selected, with compactness being the other principal consideration. The student will literally "turn his attention" from the school environment of the terminal and videodisc to the practical application and realism of the TEC, with a minimum of peripheral distraction. Such a corner arrangement normally would produce a dead space, but the otherwise wasted, extreme corner area became available for locating the speech recognition system as well as housing power supply, voltage regulation, terminal connectors, etc. These units, as well as the Micro Nova in the lower section of the TEC, are best located to be out-of-sight and out-of-mind for the student, while centrally located and easily accessible for the maintenance technician.

The sections following contain descriptions of the general arrangement, the instructor station, and the student station, and discussions of maintainability considerations and human factors considerations.

SECTION II

GENERAL ARRANGEMENT

OVERVIEW

The two major hardware subsystems of the training system are the computer suite and the student station as shown in Figure 1. The training system equipment is listed in Table 1.

The computer suite combines the computer system and the instructor station. The instructor station consists of one of the system consoles with additional special function keys, a printer and a voice system (speaker and microphone) for interaction with the student. Except for the two remaining system consoles, the computer system is housed in a single four bay cabinet and contains all the hardware necessary to interface with the student station. The computer system consists of three major groups of equipment, the instructor, the simulator and the speech equipments. The instructor equipment is housed in bays 3 and 4, the two right-most bays. Included are the S/130 computer and expansion chassis in bay 4 and the dual floppy disk drive and the bottom 20 MB disk drive in bay 3. The simulation equipment is housed in bays 2 and 3. Included are the S/130 computer, expansion chassis and the Megatek 7000 Graphics Processor in bay 2 and the top 20 MB disk drive in bay 3. The speech equipment is housed in bay 1. Included are the S/130 computer, expansion chassis, 20 MB disk drive and the Votrax Audio Response Unit.

The student station is comprised of the Training Enhancement Console (TEC), an audio/visual system (videodisc and color TV monitor), the speech recognition device and a CRT console with special function keys.

FLOOR PLAN

The training system will occupy room B116 in Building 24-B at the Fleet Combat Training Center Pacific. Equipment arrangement is shown in Figure 2. This room measures 19 feet 9 inches by 23 feet 3 inches (459 square feet).

The minimum space requirement for the training system equipment is 250 square feet: 154 square feet (22 feet by 7 feet) for the computer suite and 96 square feet (8 feet by 12 feet) for the student station. These minimums include clearances for the maintenance of the equipment. Tools and test equipment will not be stored on-site, thus there are no space requirements for these items. All maintenance will be done on-line, thus there is no requirement for an off-line maintenance work area.

The proposed installation site (room B116) meets minimum space requirements.

FACILITIES REQUIREMENTS

The space required by the equipment is shown in Figure 2 and discussed above.

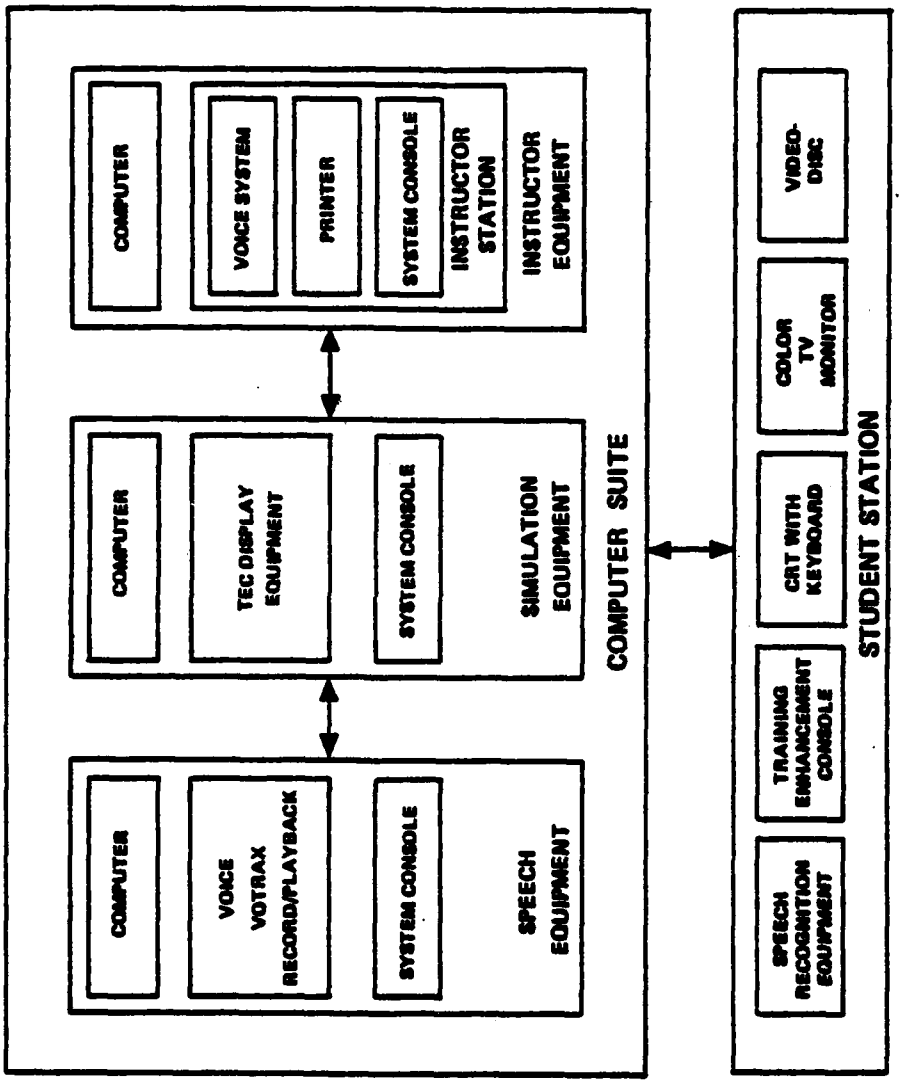


Figure 1. Training System Equipment Block Diagram

TABLE 1. TRAINING SYSTEM EQUIPMENT LIST

Item numbers in this table correspond to indicated numbers in Figures 3, 4, 6, 9, 10 and 12. Items not listed here are not specifically defined at this time: the speech recognition device and the tables and chairs.

The Voice System (speaker and microphone) and the Training Enhancement Console are being built by Logicon.

1. Documentation and Media Cabinet.

   Manufactured by Wright Line.
   Comprised of the following items:
   - 1 each 7110-10 cabinet, 84 inch
   - 2 each 8911-01 wire rack for 5440 disk packs
   - 1 each 8933-24 pullout hanging frame
   - 1 each 8917-24 pullout documentation pivot
   - 1 each 8904-24 stationary hanger bar
   - 2 each 3743-24 diskette tray

   Documentation binders:
   - 2962-32 cartridge, 1-1/2 inch manual size
   - 2997-22 cartridge cover manual size
   - 2880-32 document binder 11 x 15

2. Single Bay Cabinet, Model 1012P.

   Manufactured by Data General.

3. Eclipse S/130 Computer, Model 8611-PA, with 192 KW MOS memory, MAP, battery backup, ERCC, floating point, MCA, disk controller, RS232 and RTC. Manufactured by Data General.

4. 12 Slot Expansion Chassis, Model 8537.

   Manufactured by Data General.

5. 20 MB Cartridge Disk, Model 6070.

   Manufactured by Data General.

6. Dual Floppy Diskette, Model 6030.

   Manufactured by Data General.

7. Dasher CRT Display Terminal, Model 6053.

   Manufactured by Data General.

8. Dasher LP2 Printer, Model 6088.

   Manufactured by Data General.

TABLE 1. TRAINING SYSTEM EQUIPMENT LIST (CONTINUED)

9. ADM-3A CRT Display Terminal.

   Manufactured by Lear Siegler.

10. VOTRAX Audio Response System.

    Manufactured by Federal Screw Works.

11. Model 7000 Graphics Display Processor.

    Manufactured by Megatek.

12. Wire Paper Basket, Model 1172A.

    Manufactured by Data General.

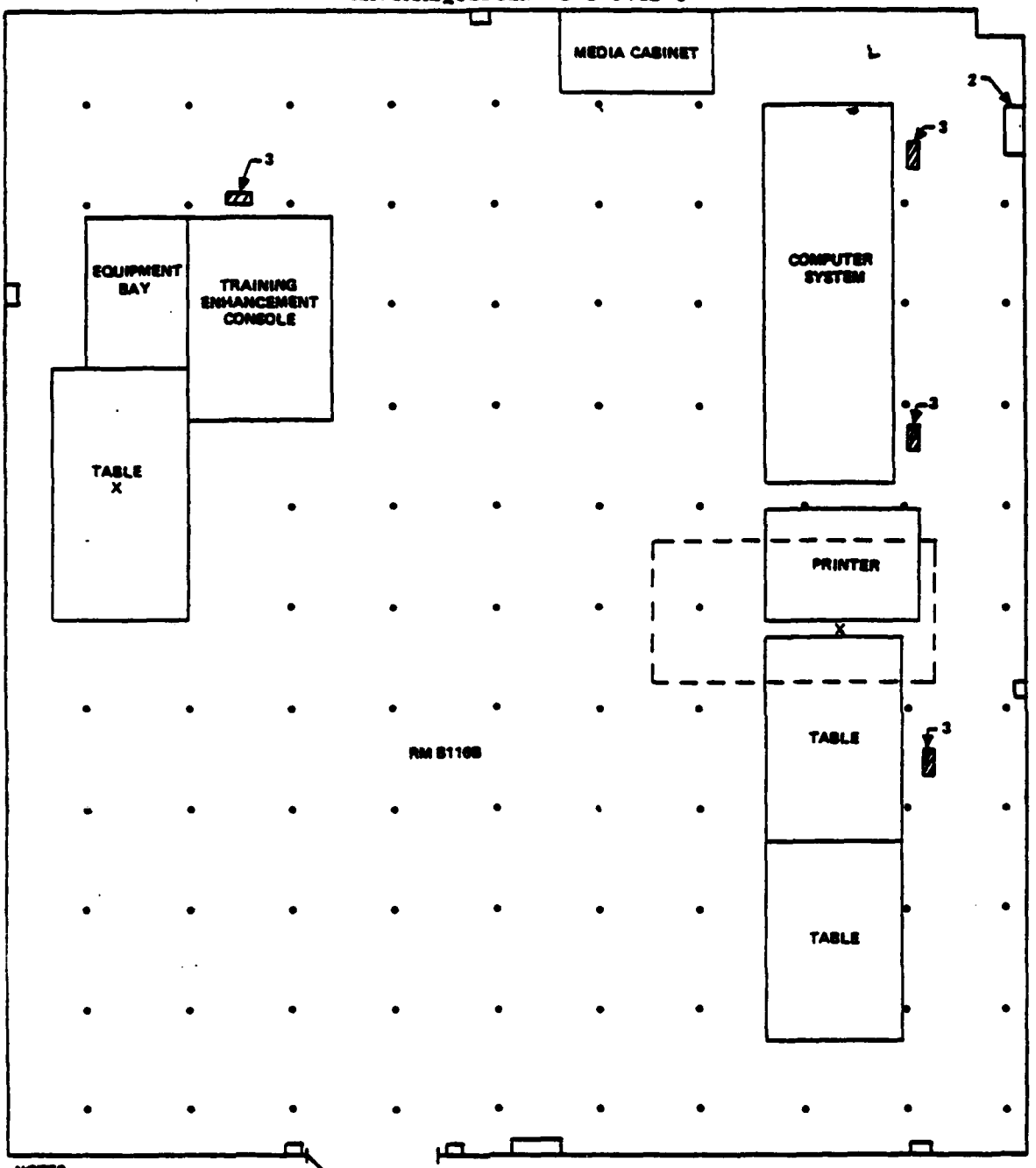
13. Videodisc Player, Model PR 7820

    Manufactured by MCA.

14. 12 Inch Color Monitor, Model CVM-1250.

    Manufactured by Sony.

15. Micro Nova Computer, Model 8560 with 16 KW MOS memory, downline load, handheld programmers console, RS232, RTC, digital I/O and analog to digital converter. Manufactured by Data General.



NOTES:

1. X = POSITION OF FLUSH MOUNTED LIGHTING.
2. POWER PANEL
3. FLOOR CUTOUTS APPROXIMATELY 3 X 6 CENTERED ON ONE EDGE OF TILE.

Figure 2. Training System Equipment Arrangement in Room B116, Building 24-B, FLECOMBATRACENPAC, San Diego

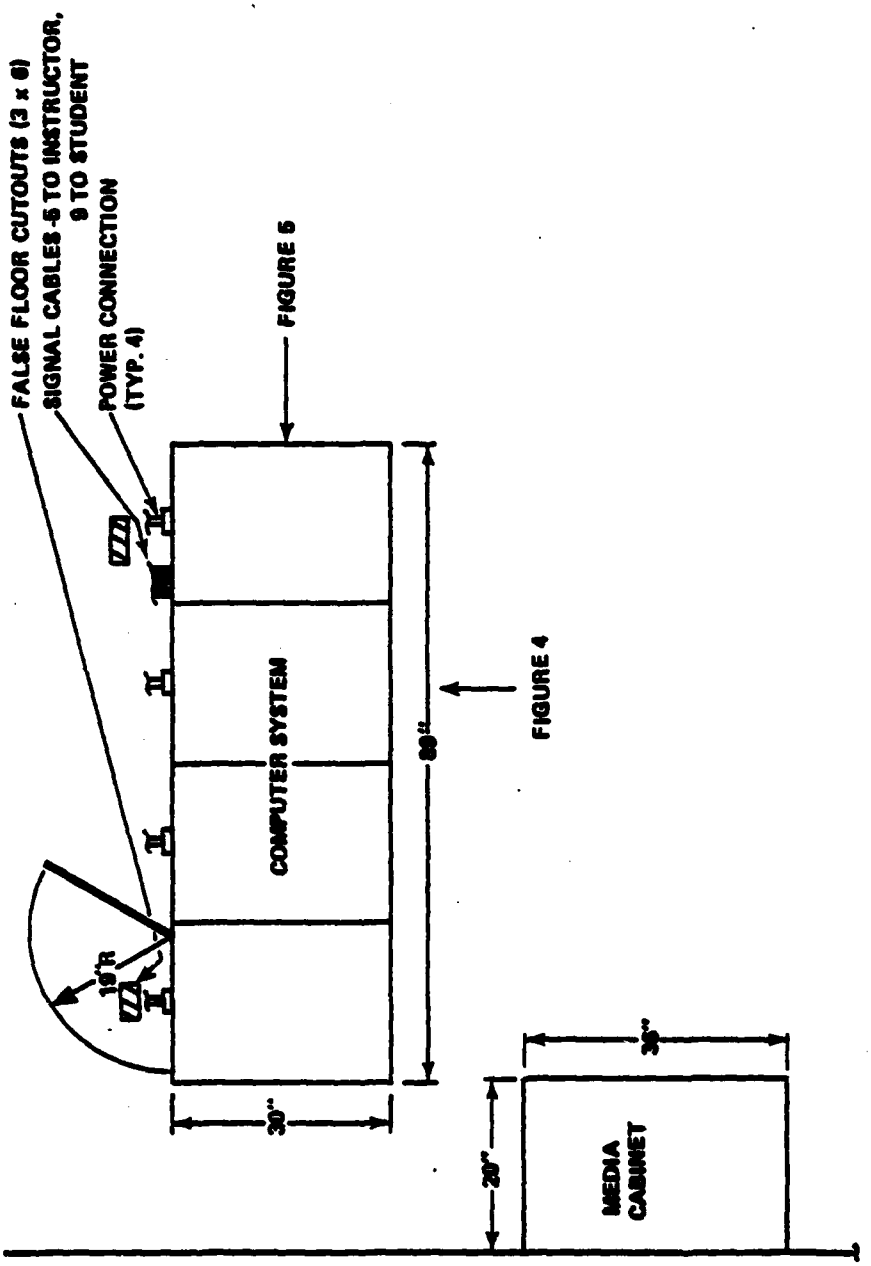


Figure 3. Computer System Plan View

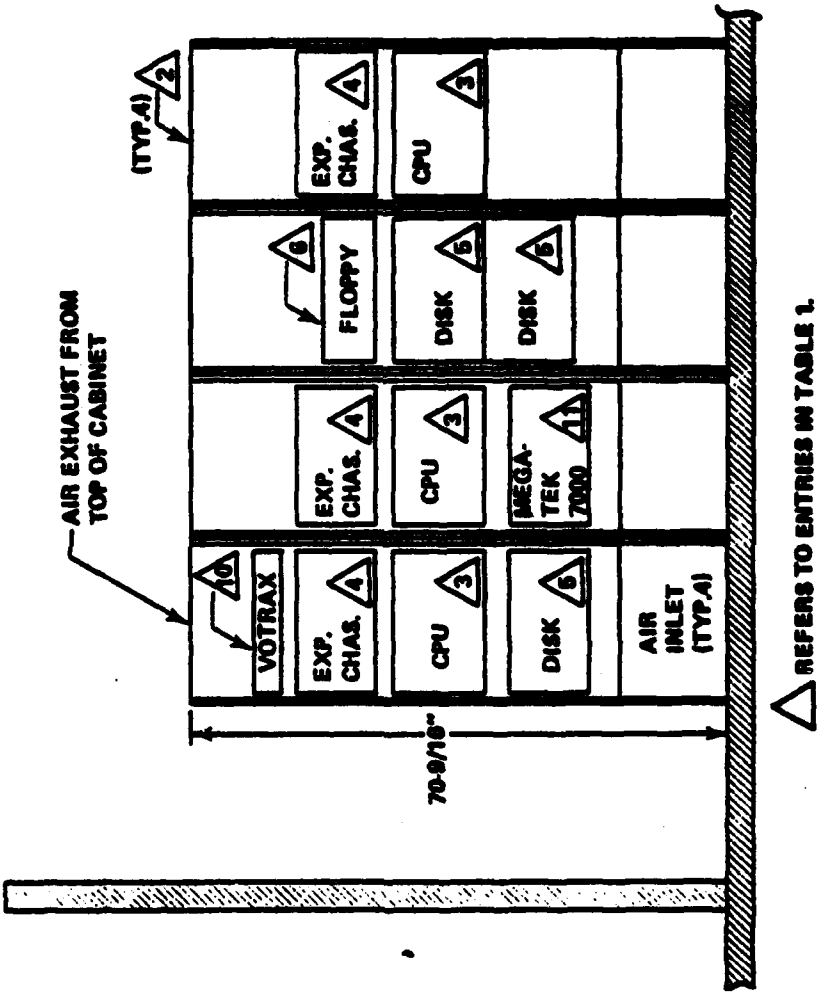


Figure 4. Computer System Elevation View

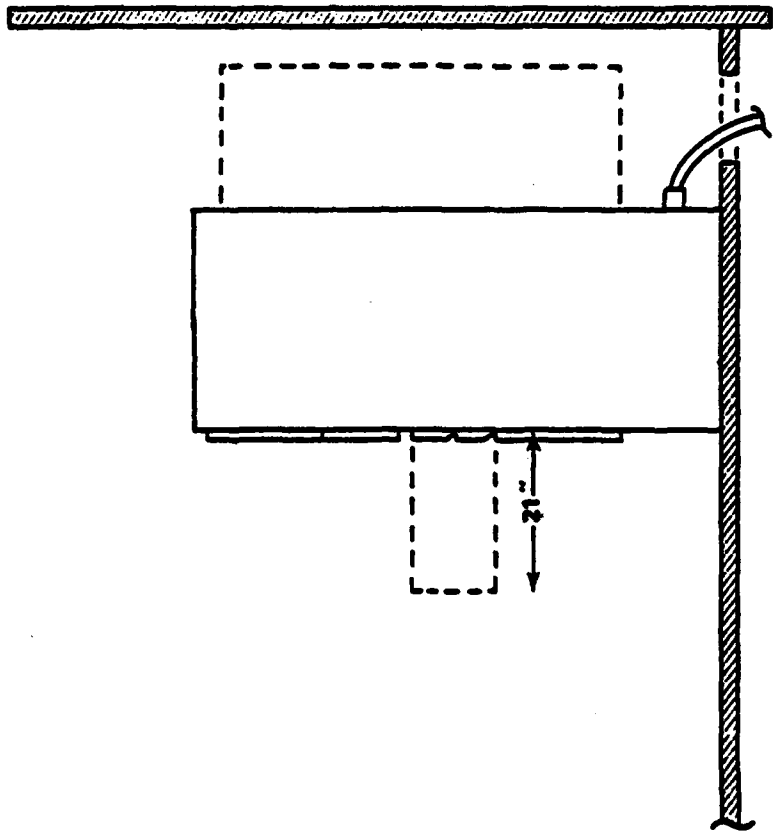


Figure 5. Computer System Section View

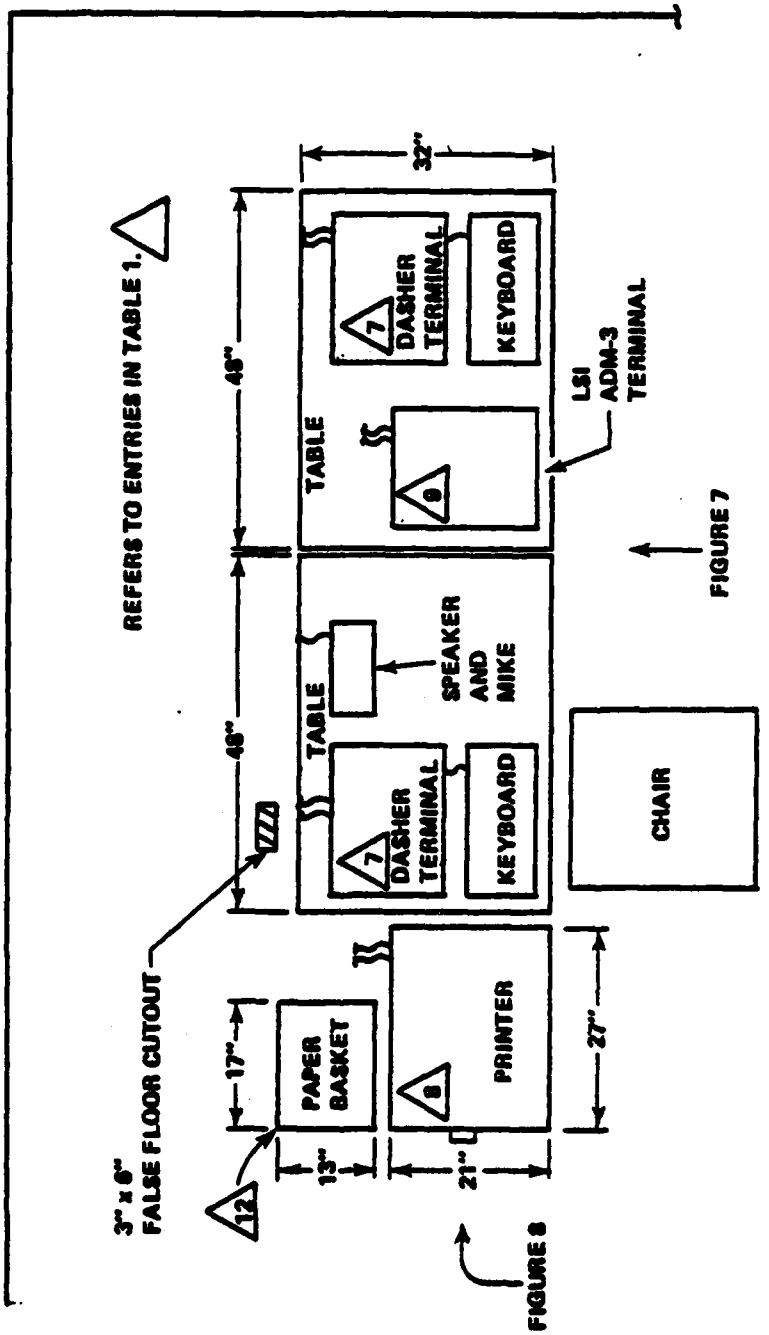


Figure 6. Instructor Station Plan View

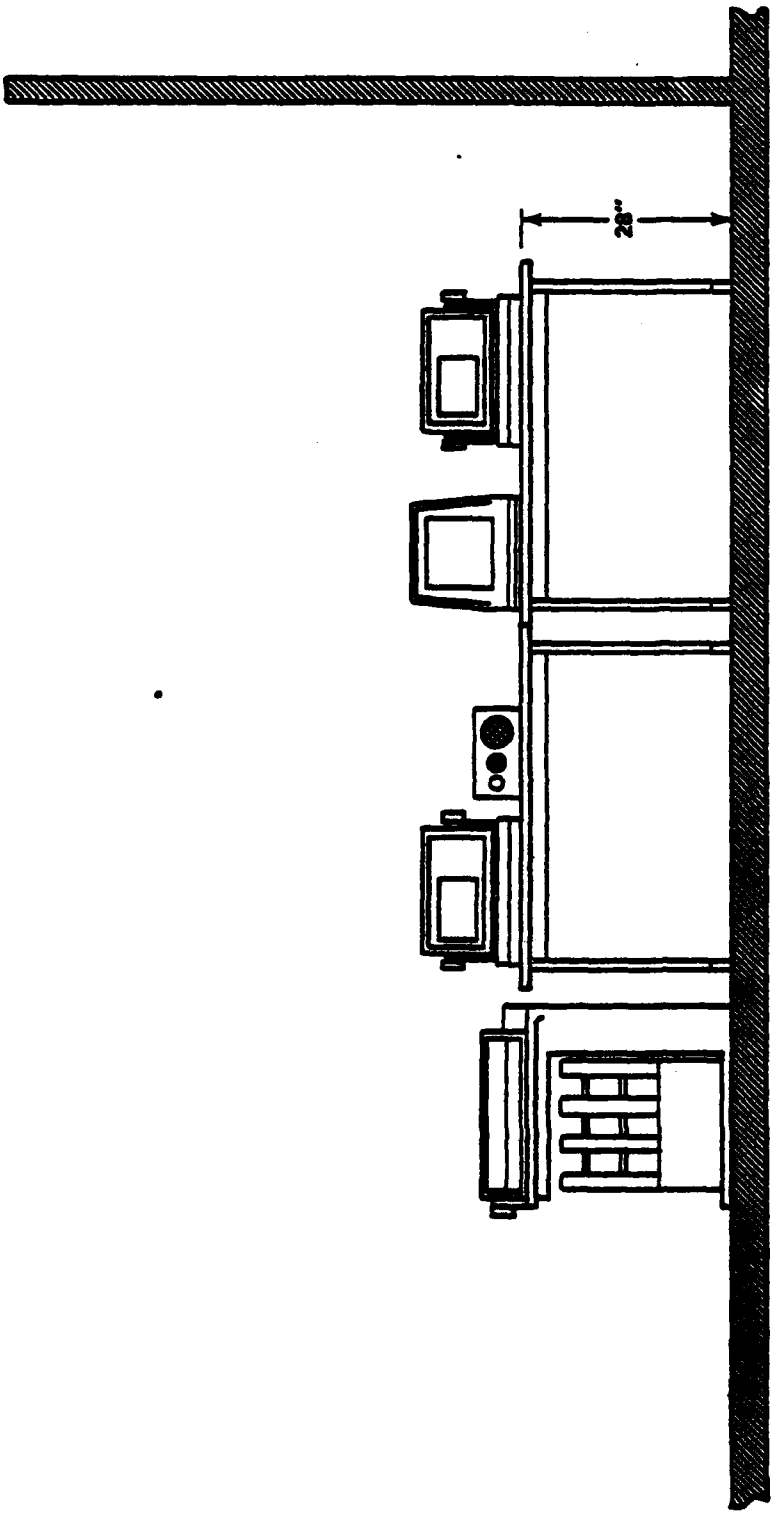


Figure 7. Instructor Station Elevation View

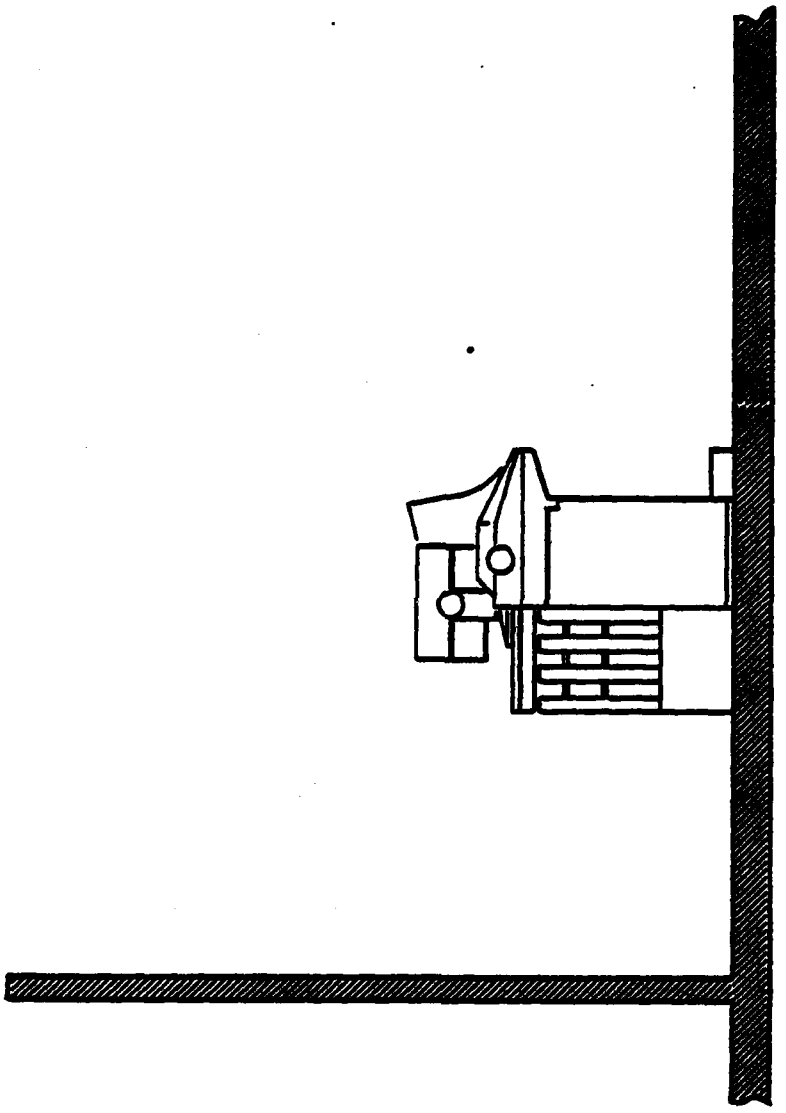


Figure 8. Instructor Station Section View

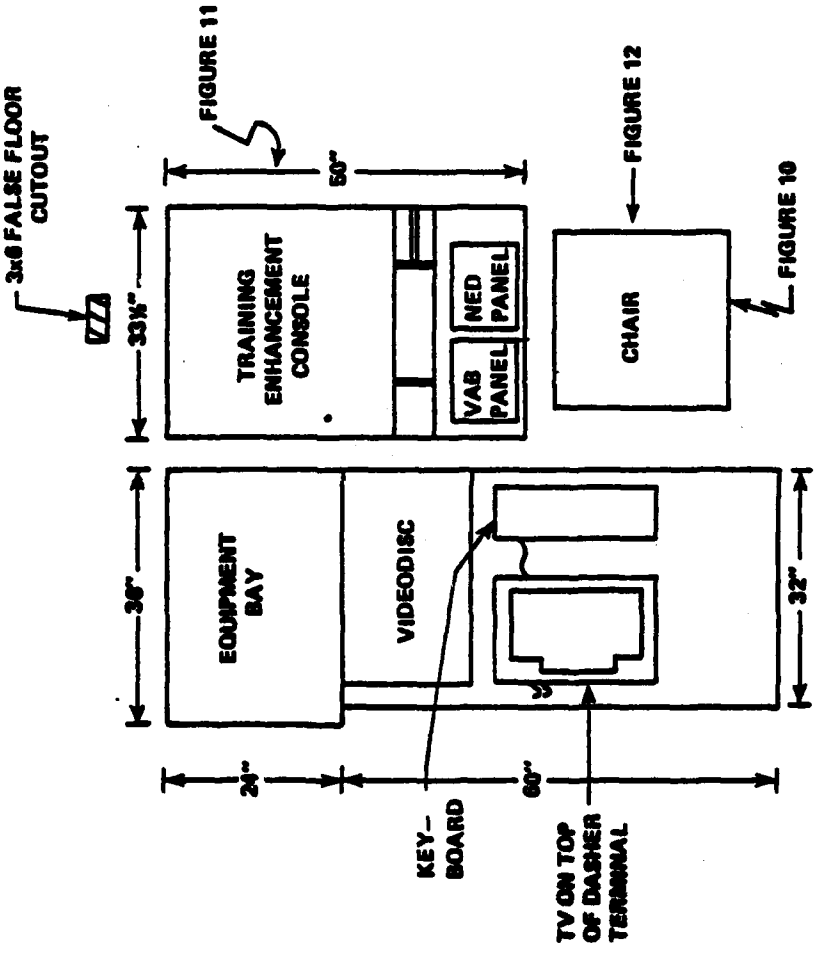


Figure 9. Student Station Plan View

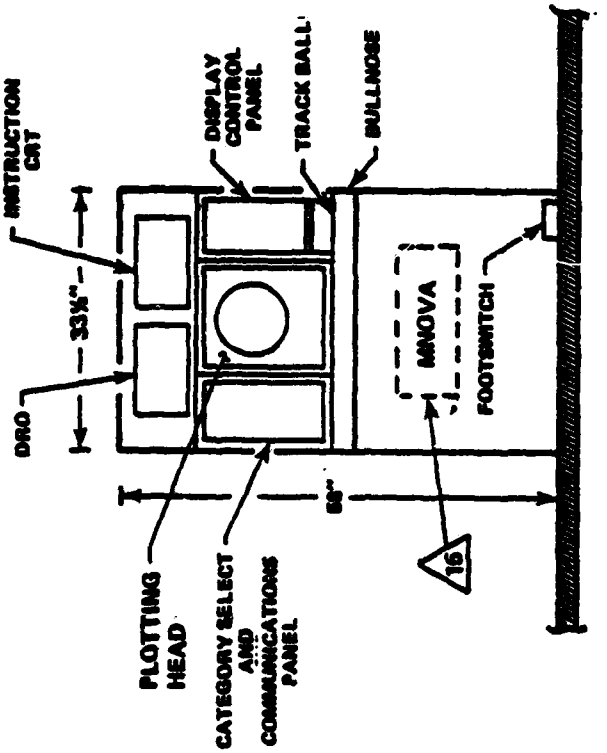


Figure 10. Student Station TEC Elevation View

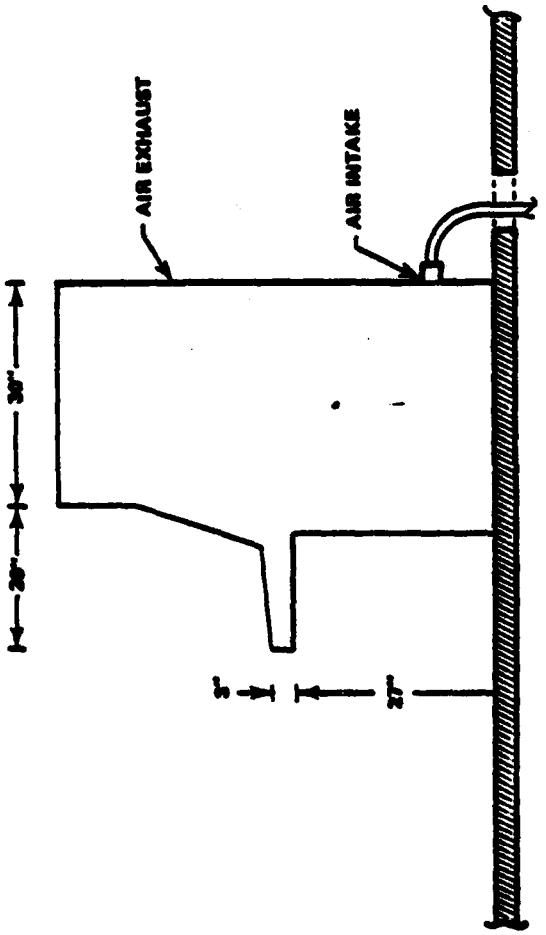


Figure 11. Student Station TEC Section View

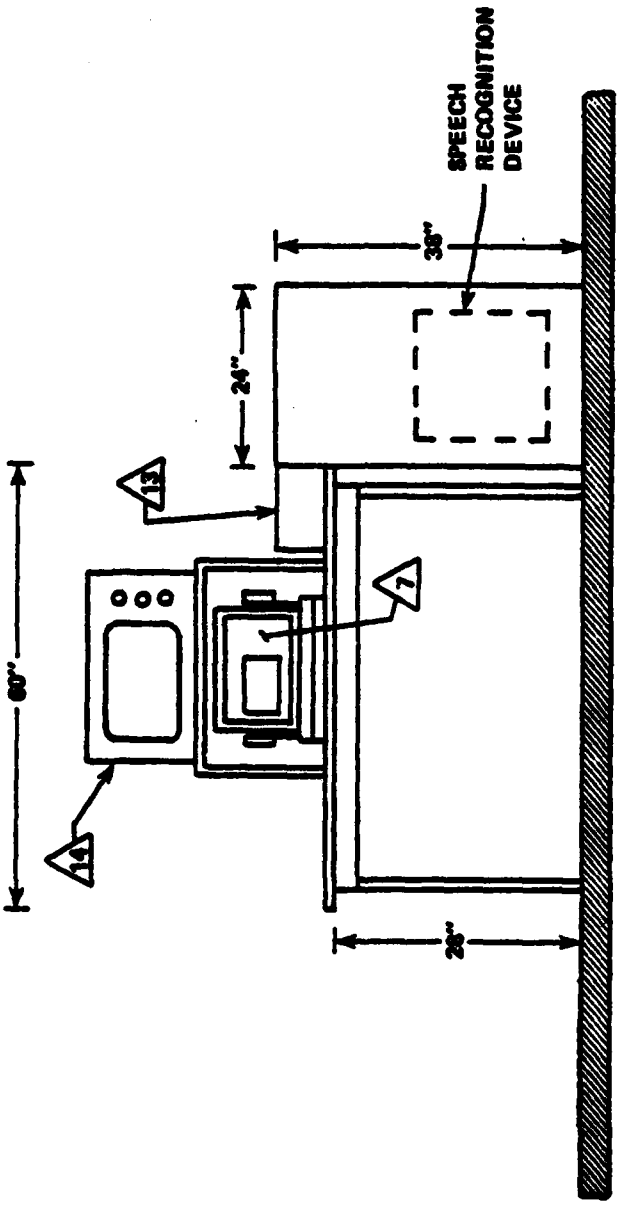


Figure 12. Student Station,Audio/Visual Equipment Elevation View

Doorways should be a minimum of 34 inches.

The floor plans shown assume false floors for cable routing.

Maximum floor loading for the computer suite is approximately 170 pounds per square inch under the four casters of the speech computer equipment bay. Maximum floor loading for the student station is approximately 100 pounds per square inch under the feet of the Training Enhancement Console.

Cooling requirements are approximately 46,000 BTUs per hour for the training system (13,500 watts). All equipments house their own blowers, thus an ambient temperature of 60 to 70 degreees and a relative humidity of 20 to 90 percent are sufficient.

Power outlets required are four single phase, 240 volt, 24 amp, 3 wire and ground, L14-30R connectors for the four computer system cabinets; one duplex single phase, 115 volt, 20 amp, 3 wire, 5-15R connector for the remainder of the computer suite equipment; one duplex single phase, 115 volt, 20 amp, 3 wire, 5-15R connector for the student station equipment.

There are no special grounding requirements. All grounding will be accomplished via power line safety grounds.

The training system will require two individually controlled, variable brightness, white lights flush mounted in the ceiling at the locations shown in Figure 2. In addition, normal room lighting controlled from a single location is required.

A thirty pound fire extinguisher suitable for class C electronic fires should be available for the computer suite and student station. The preferred type is HALON 1211. No other safety requirements are necessary since all hazardous voltages, etc., are well protected within the equipment enclosures and since all maintenance on the training system will be performed by the contractor.

The floor plans shown provide the minimum required maintenance clearances for all the equipments. Storage space is provided by the documentation and media cabinet.

EQUIPMENT DETAILS

This portion deals with the computer suite equipments that the instructor will be using while operating the training system. The specific equipments used at the instructor and student stations are covered under their respective sections.

COMPUTER SYSTEM. The computer system described below includes the equipment bays, the computers and the disks.

Main Power. The main power circuit breakers for the four computer system cabinets are located at the lower rear of the cabinets. With the breakers in the

on (up) position, power is applied to the cabinet blowers, the VOTRAX, and the Megatek 7000. Power is also made available to the remainder of the equipments mounted in the cabinets.

Computers. The Central Processing Units comprise three Data General Model 8611-PA Eclipse Computers, expansion chassis, and various memory boards. Figure 13 illustrates the Eclipse Computer front panel. Instructions for programming the Eclipse Computer are contained in User's Manual - Programmer's Reference for Eclipse Line Computers (DGC Document No. 015-000024). A brief functional description of the controls and indicators is included here.

Indicator Lights. The indicator lights on the Eclipse Computer front panel reflect the current state of the computer. If a light is lit, it means the corresponding bit is 1; if the light is not lit, the corresponding bit is 0. All lights are red colored. Table 2 describes the functions of the various lights.

Console Switches. In a row along the bottom of the console are 26 switches. These are broken down into three groups; 5 function switches, 16 data switches, and 5 more function switches. The 10 function switches are spring loaded. When pushed up, they perform one function, when pushed down, they perform another function. When released, these switches return to a neutral "off" position. The 16 data switches are two-position toggle switches. When in the up position, they represent a 1; when in the down position, they represent a 0. These switches have no neutral position. These 16 switches can be used to enter either data or addresses. If the switches are to be interpreted as data, all 16 data switches are used and they correspond to the bits in an internal 16-bit word. The left-most switch of this group corresponds to bit 0, and the right-most switch corresponds to bit 15. If the switches are to be interpreted as an address, only the right-most 15 switches are used. When interpreted as an address, the second switch from the left is the high-order bit of the address and the right-most switch is the low-order bit. All addresses coming from the console are treated as logical addresses.

Starting from the left of the console and proceeding to the right, the function switches and their purposes are described below.

a. RESET/STOP. When this switch is pushed up, the RESET function is performed and an I/O RESET instruction is executed. The CPU is stopped after completing the current processor cycle. While in this state, the CPU will honor data channel requests. When this switch is pushed down, the STOP function is performed. The CPU is stopped after completing the current instruction and before executing the next instruction.

b. DEP/EXAM. The next four switches are the accumulator DEPOSIT/EXAMINE switches. The switches are numbered 0-3 from left to right. Each switch affects only its corresponding accumulator. When one of these switches is pushed up, the current setting of the data switches is deposited into the corresponding accumulator. The data lights display the information placed in the accumulator. When one of these switches is pushed down, the contents of the corresponding accumulator are displayed in the data lights.

TABLE 2. CPU INDICATOR LIGHT FUNCTIONS

LIGHT	MEANING WHEN LIT
USER MODE	The MAP feature is translating addresses in the user mode.
ADDR COMPARE	Operation of the machine is suspended because the comparison requested by the ADDRESS COMPARE switch has come up true.
ION	The Interrupt On flag is 1.
CARRY	The carry bit is 1.
ROM ADDRESS	These 10 lights display the address in the micro-code of the next micro-instruction to be fetched.
DATA	These 16 lights display what is currently in general register 0 of the micro-code processor.
ADDRESS	These 15 lights display what is currently in the memory address bus.

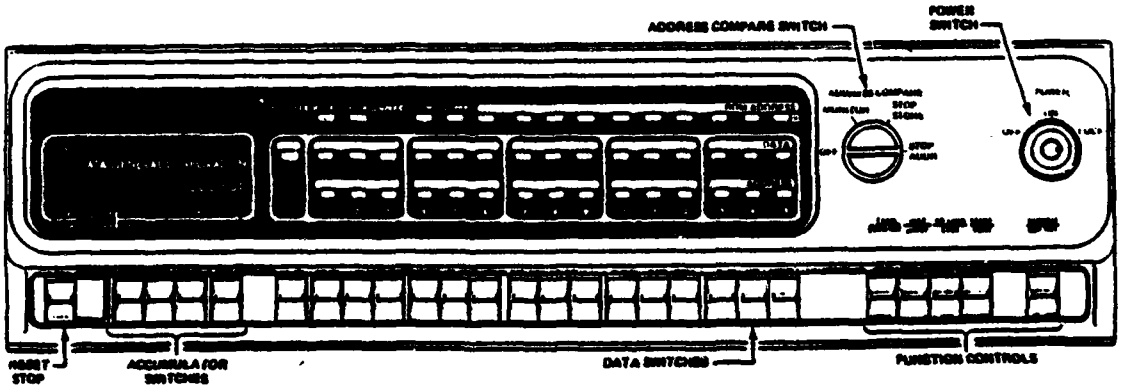


Figure 13. Eclipse S/130 Computer Front Panel

c. EXAM/EXAM NXT. When this switch is pushed up, the EXAMINE function is performed. The address indicated by data switches 1-15 are placed in the program counter. This value is displayed in the address lights. The contents of the word addressed by the program counter are then read and displayed in the data lights. When this switch is pushed down, the EXAMINE NEXT function is performed. The current value of the program counter is incremented by one and the new value is displayed in the address lights. The contents of the word addressed by the updated value of the program counter are then read and displayed in the data lights.

d. INST/ INST. When this switch is pushed up, the INSTRUCTION STEP function is performed. The instruction contained in the word addressed by the current value of the program counter is executed and then the CPU is stopped. The address lights display the updated value of the program counter. When this switch is pushed down, the MICRO-INSTRUCTION STEP function is performed. The next micro-instruction in logical sequence is performed and the micro-code processor is stopped.

e. PR LOAD/EXEC. When this switch is pushed up, the program load function is performed. The contents of the bootstrap read-only memory are placed in memory locations 0-37$_8$ and a "JMP 0" instruction is performed. When this switch is pushed down, the EXECUTE function is performed. The current setting of the data switches is interpreted as an instruction and that instruction is executed as if it were in memory at the location specified by the program counter.

f. START/CONT. When this switch is pushed up, the START function is performed. The address indicated by data switches 1-15 is placed in the program counter, and sequential operation of the processor begins with the word addressed by the updated value of the program counter. When this switch is pushed down, the CONTINUE function is performed. Sequential operation of the processor continues from the current state of the machine.

g. DEPOSIT/DEP NXT. When this switch is pushed up, the DEPOSIT function is performed. The current setting of the data switches is placed into the word addressed by the current value of the program counter. When this switch is pushed down, the DEPOSIT NEXT function is performed. The program counter is incremented by one and the current setting of the data switches is placed into the word addressed by the updated value of the program counter.

h. ADDRESS COMPARE. The ADDRESS COMPARE switch is a four-position rotary switch. The four positions are labeled "OFF", "MONITOR", "STOP/STORE", and "STOP/ADDR". The functions of these four positions are described below.

(1) OFF – When the switch is in the OFF positon, the ADDRESS COMPARE feature is disabled.

(2) MONITOR – When the switch is in the MONITOR position, it is possible to examine and monitor locations in memory while the CPU is running.

(3) STOP/STORE – With the switch in the STOP/STORE position, the ADDRESS COMPARE feature will suspend the operation of the CPU if the CPU tries to alter the location whose address is set in the data switches.

(4) STOP/ADDR – With the switch in the STOP/ADDR position, the ADDRESS COMPARE feature will suspend the operation of the CPU if the CPU tries to access the location whose address is set in the data switches.

i. POWER. The POWER switch is a three-position key switch. The three positions are labeled "OFF," "ON," and "LOCK." With the switch in the OFF position, all power to the CPU is shut off and the machine will not run. Turning the switch to the LOCK position allows the key to be removed. While the switch is in the LOCK position, all console functions except the MONITOR function of the ADDRESS COMPARE feature are disabled.

20MB Disks. Operator controls for the disk are located on the front panel of the disk drive. The control arrangement is shown in Figure 14, and the controls and indicator functions are described in Table 3.

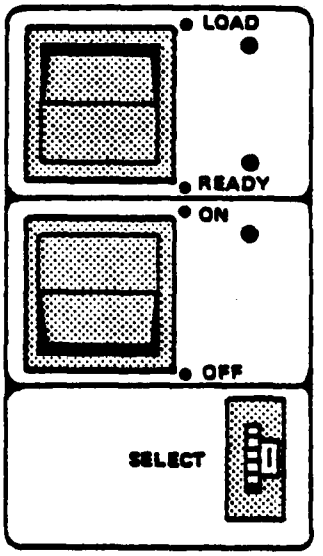


Figure 14. 20MB Disk Controls and Indicators

TABLE 3. DISK CONTROL FUNCTIONS

Control	Function
ON/OFF rocker switch	Turns power ON or OFF to disk drive.
	Switch is set to ON as first step to bring disk drive on-line with computer. Drive cannot slide out of cabinet to load cartridge disk unless this switch is ON.
	Switch is set to OFF to completely shut down disk drive. LOAD indicator light should be illuminated before turning switch OFF.
	NOTE: LOAD/RUN switch should be in LOAD position and LOAD light should be lit before trying switch.
ON (red indicator light)	When lit, indicates power is supplied to drive at proper levels.
	When OFF, indicates drive is completely shut down or power is at low level.
LOAD/READY rocker switch	Starts and stops disk drive; permits loading and unloading cartridge disk by unlocking drive from cabinet.
	Set to LOAD to stop disk drive, and to unlock drive to slide out of cabinet and thereby permit a cartridge disk to be loaded. This switch should be in LOAD position before turning off power to drive.
	Set to READY to start the disk drive. Do NOT set to READY unless the cartridge disk is loaded and the drive is slid back into the cabinet.
LOAD (red indicator light)	When ON, indicates that the drive is stopped; the drive can be extended on the slides, and the cartridge disk may be interchanged. The disks may continue rotating for up to 1 second after the load light illuminates.
	When OFF, indicates that the drive is locked in the cabinet.
READY (red indicator light)	When ON, indicates that the drive is on-line with the computer, has no faults or interlocked to inhibit operation. This light is OFF during load operations.
	When OFF, indicates that the drive is not on-line, or fault is set to inhibit operation. This light is OFF during load operations.
	NOTE: The READY light may blink on and off during normal operation. This is no cause for concern unless the light remains extinguished for more than one second. The READY light is OFF during the time when the drive is seeking to a cylinder.
SELECT thumbwheel switch	Selects the logical unit number for the drive.
	This switch is used to assign logical unit number 0, 1, 2 or 3 to the disk drive, as indicated by the number displayed. Normally, this number is set at installation and need not be changed. NEVER change the switch setting when the disk drive in on-line, or data may be lost; if necessary to change the setting, ensure that the drive is off-line.

Floppy Disk. Operator controls for the dual flopy disk drive are located on the front panel of the drive. The control arrangemment is shown in Figure 15 and the controls and indicator functions are described in Table 4.

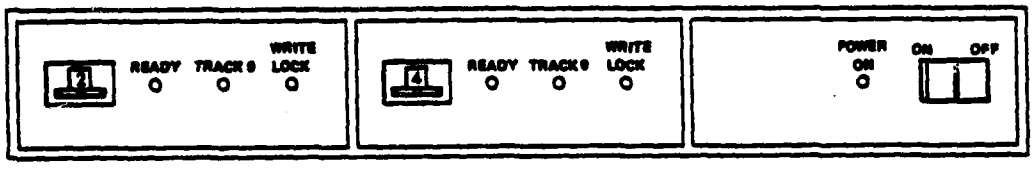


Figure 15. Floppy Disk Controls and Indicators

TABLE 4. FLOPPY DISK CONTROL FUNCTIONS

Control	Function
ON/OFF rocker switch	Turns power ON or OFF to disk drive. Power should not be cycled if a diskette is inserted in either drive.
ON (red indicator light)	When lit, indicates power is supplied to the drives.
SELECT thumbwheel switch	Selects the logical unit number for the drive. The four positions are labeled 0 through 3. Never change the switch when the READY light is glowing; the READY light indicates that the drive is operating on-line with the computer. Data on any or all diskettes may be lost if the unit select switch is changed at this time. It is good practice to change the unit number only when the drive door is open and/or the drive power is off. Never assign the same unit number to more that one drive.
READY (red indicator light)	When ON, indicates the drive is not executing a seek command and is ready to receive an instruction.
TRACK 0	When ON, indicates the read/write head is positioned at track 0.
WRITE LOCK	When ON, indicates the diskette in the drive is write protected. (Write protect hole in diskette is exposed.)

DASHER CRT DISPLAY TERMINALS. Three of these terminals are used in the system. One is the system console for the speech computer. One doubles as the system console for the instructor computer and as the instructor station CRT. The third is the student station CRT. The terminals serve as a communication link between the operator and the computer. Each terminal has a display unit, which displays alphanumerics formatted as 24 lines, 80 characters per line; and a keyboard, which has a typewriter-style, 56 key, main keypad, an 11 key numeric keypad, an 11 key screen management keypad and 12 user defined keys. Figure 16 shows the display controls and the keyboard. Table 5 describes the display control functions. The special function keys for the instructor and student stations are the user-defined keys and the screen management pad and are described under their respective sections.

TABLE 5. DASHER CRT DISPLAY CONTROL FUNCTIONS

Control	Function
ON/OFF/ BRIGHTNESS	The power switch and CRT screen brightness control are combined in this single control knob. Pulling the knob out turns the display power on; pushing it in turns the power off. Rotating the knob clockwise makes the screen image brighter.
DATA RATE rotary switch	The data transmission rate is selected by moving the DATA RATE rotary switch to one of its ten positions. The band rate selected by each position is marked on the panel. The normal setting is 9600 baud.
PARITY	The parity computation performed by the terminal is selected by moving the PARITY slide switch to one of its three positions: EVEN, ODD or in the center, unmarked position for mark parity. The normal setting is the center position.
MODE	The operating mode of the terminal is selected by moving the MODE slide switch to one of its two positions: LINE or LOCAL. In LINE mode, information entered in the keyboard is transmitted to the computer and information received from the computer is sent to the display. In LOCAL mode, information entered in the keyboard is sent directly to the display and the display does not receive information from the computer. The normal setting is LINE.

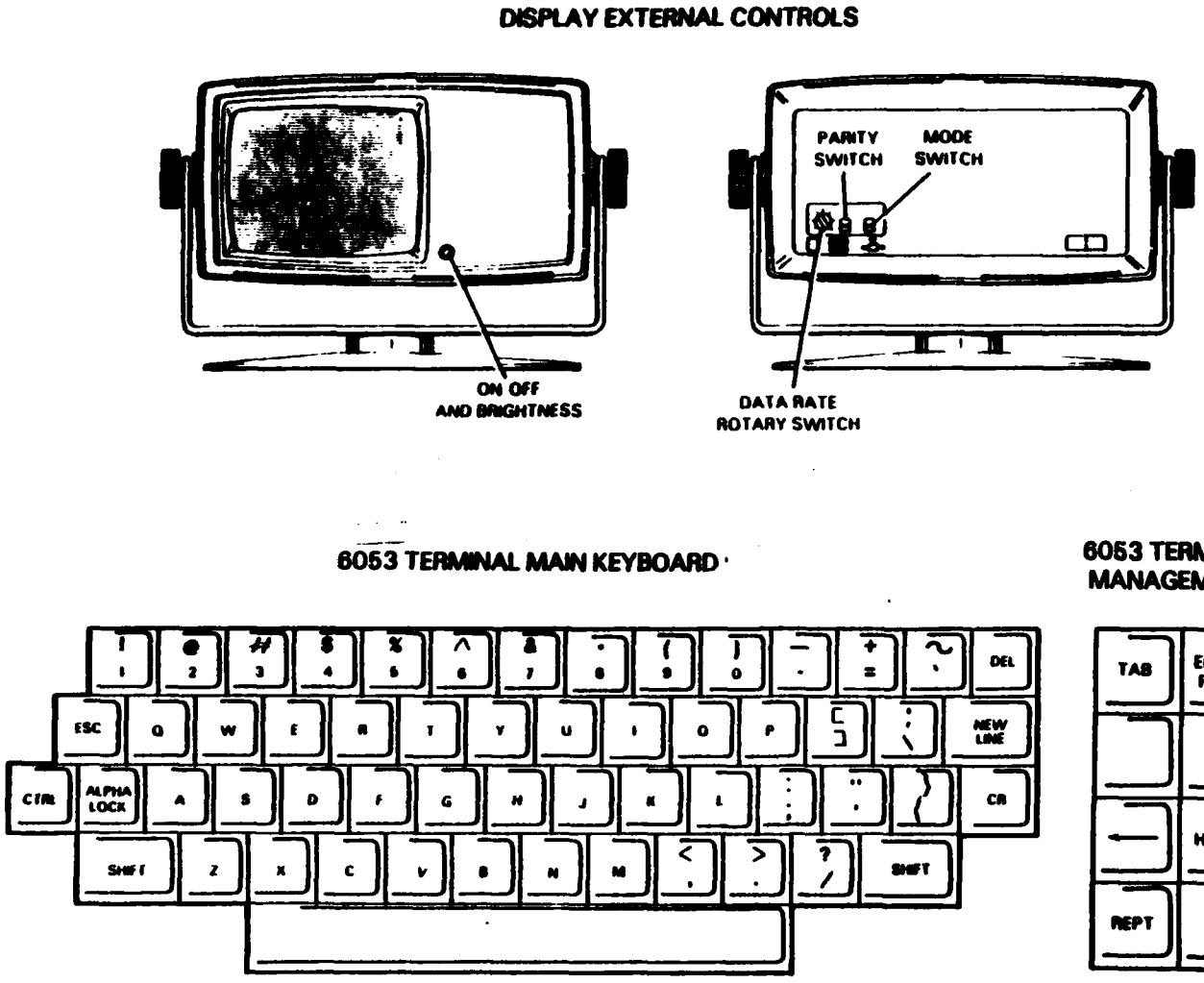


Figure 16. Dasher CRT Display Terminal Details

ADM-3A CRT DISPLAY TERMINAL. This terminal is the system console for the simulation computer. The terminal has an ON/OFF power switch on the rear panel, a keyboard (Figure 17) for inputting data, a contrast control for varying display brightness, and 33 toggle-type switches which are used to select the primary terminal operating characteristics desired. Thirteen of these switches are located on printed circuit boards inside the terminal case and are set at the factory. The remaining 20 are located under the identification plate adjacent to the keyboard (Figure 17). These switches are also preset, but can be changed to vary terminal operating characteristics as desired. These switches and their functions are described in Table 6.

TABLE 6. ADM-3A FRONT PANEL TOGGLE SWITCHES

Switch	Function
BIT 8-0 — 1	This switch has effect only with DATA-7 — 8 switch in 8 position. In BIT 8-0 position, bit 8 is forced to zero value. In 1 position, bit 8 is forced to a one value. Normal setting is 0.
PARITY — INH	In PARITY position, bit following 7- or 8-bit data word is parity bit (parity enabled). In INH position, no parity bit will be generated (parity inhibited). Bit following data word will be (first) stop bit. Normal setting is INH.
STOP — 1 — 2	In STOP-1 position, one stop bit is generated. In 2 position, two stop bits are generated. Normal setting is 1.
DATA — 7 — 8	In DATA-7 position, 7-bit data word length is selected. In 8 position, 8-bit data word length is selected. (8-bit word consists of standard 7-bit data word plus 8th bit forced to one or zero according to setting of BIT 8-0 -1 switch.) Normal setting is 8.
PARITY — ODD — EVEN	This switch has effect only with PARITY — INH switch in PARITY position. In PARITY — ODD position, selects odd parity. In EVEN position, selects even parity.
LC EN — UC	In LC EN position, SHIFT key is fully operational, allowing generation of both upper and lower case character codes. In UC position, only upper case alphabetic characters will be generated, regardless of whether or not SHIFT key is held down. SHIFT key remains operational for all nonalphabetic keys. Normal setting is EN.

TABLE 6. ADM-3A FRONT PANEL TOGGLE SWITCHES (CONTINUED)

Switch	Function
AUTO NL — OFF	In AUTO NL position, typing in 80th character position will automatically cause cursor to move to first position of next line. If data was being entered on bottom line, entire display scrolls upward, presenting new (bottom) line for data entry. Operator continues typing on next new line. In OFF position, automatic NEW LINE function is disabled. Continued typing at 80th character position transmits each new character and changes 80th character on display. Normal setting is AUTO NL.
RS-232-CL	In RS-232 position, selects RS-232C communications at MODEM (computer) interface connector on rear panel. In CL position, selects 20MA current loop communications at MODEM interface connector. Normal setting is RS-232.
HDX — FDX	In HDX position, selects half duplex operation. Characters typed are transmitted and automatically echoed back from ADM-3A I/O Channel for display. In FDX position, selects full duplex operation. Characters typed are displayed only if echoed back by computer or modem. Normal setting is FDX.
Communication Rate Switches 19200 9600 B 4800 A 2400 U 1800 D 1200 600 R 300 A 150 T 110 E 75	These switches are used to select send/receive rate for data communications with computer and auxiliary device. Setting one switch to left-hand (BAUD RATE) position selects the associated rate. Normal setting is 9600.

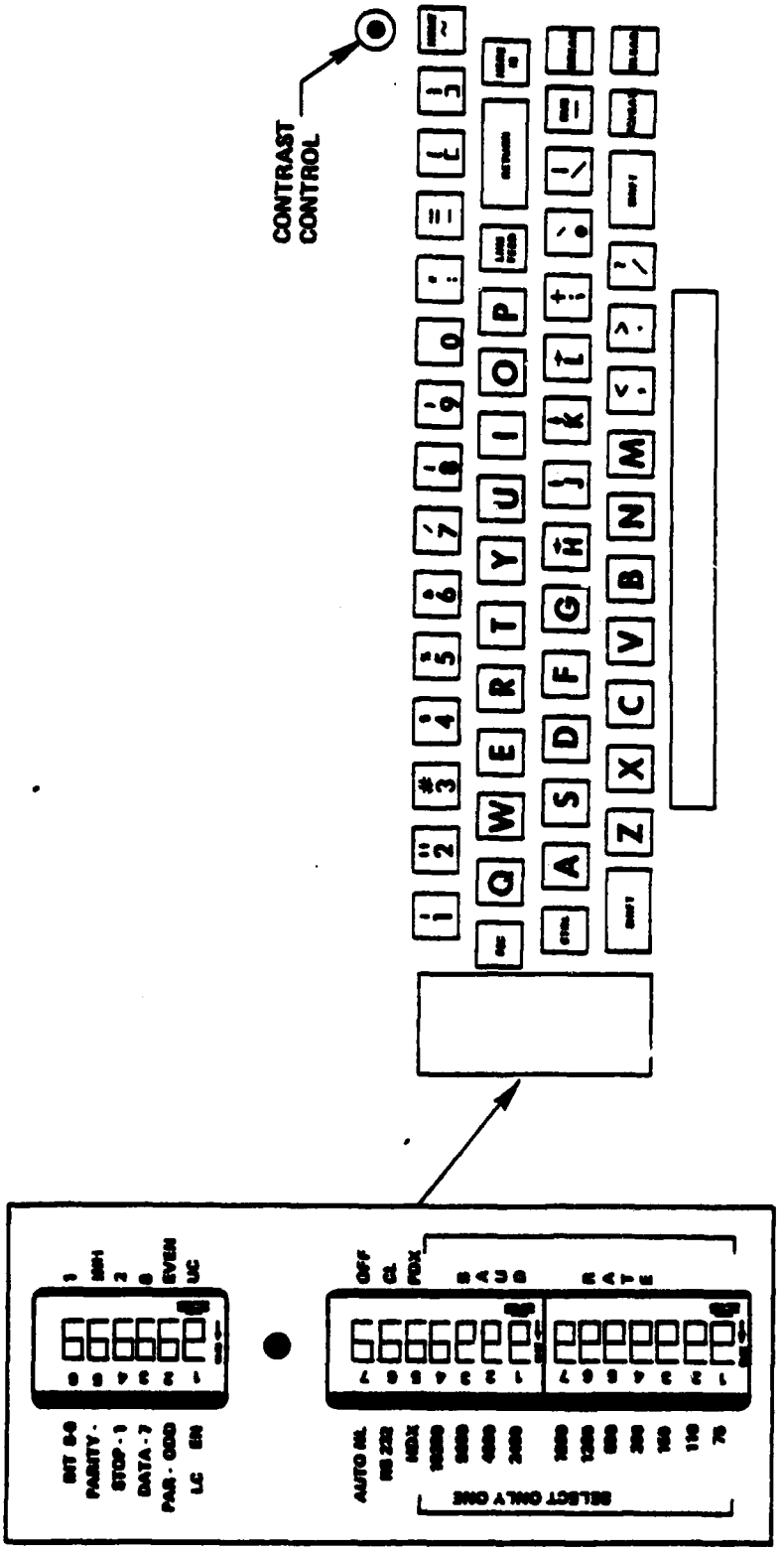


Figure 17. ADM-3A CRT Display Terminal Details

VOTRAX. The VOTRAX Audio Response Unit is located behind the top front panel of the speech equipment cabinet. Operator controls are shown in Figure 18, and the controls and indicator functions are described in Table 7.

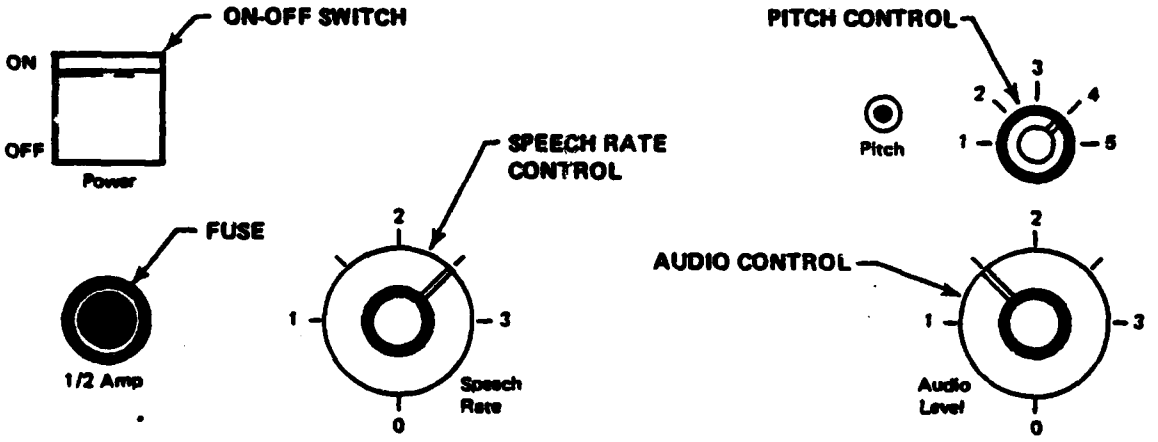


Figure 18. VOTRAX Details

TABLE 7. VOTRAX CONTROL FUNCTIONS

Control	Function
POWER rocker switch	When ON, power is applied to the unit and the switch lights. Normally left ON.
SPEECH RATE potentiometer	Controls the rate at which words are spoken from the VOTRAX. The dial is marked 0 through 3-1/2 with 0 being the slowest rate. The normal setting is 2.
AUDIO LEVEL potentiometer	Adjusts the audio output volume. The dial is marked 0 through 3-1/2 with 0 being the lowest volume. The normal setting is 3-1/2.
PITCH potentiometer	Varies the center frequency of the audio output bandwidth. Thus, it varies the pitch of the voice output. The dial is marked 1 through 5 with 1 being the lowest pitch. The normal setting is 3.

SECTION III

INSTRUCTOR STATION

OVERVIEW

The instructor station equipment is comprised of a voice system (a speaker for monitoring the student and computer generated audio and a microphone for communication with the student), a Dasher printer for hardcopy, and the instructor computer system console (Dasher CRT display terminal) with special function keys for scenario and training control.

VOICE SYSTEM

Figure 19 shows an artist's conception of the voice system. The system consists of an enclosure containing a microphone, speaker and a volume control.

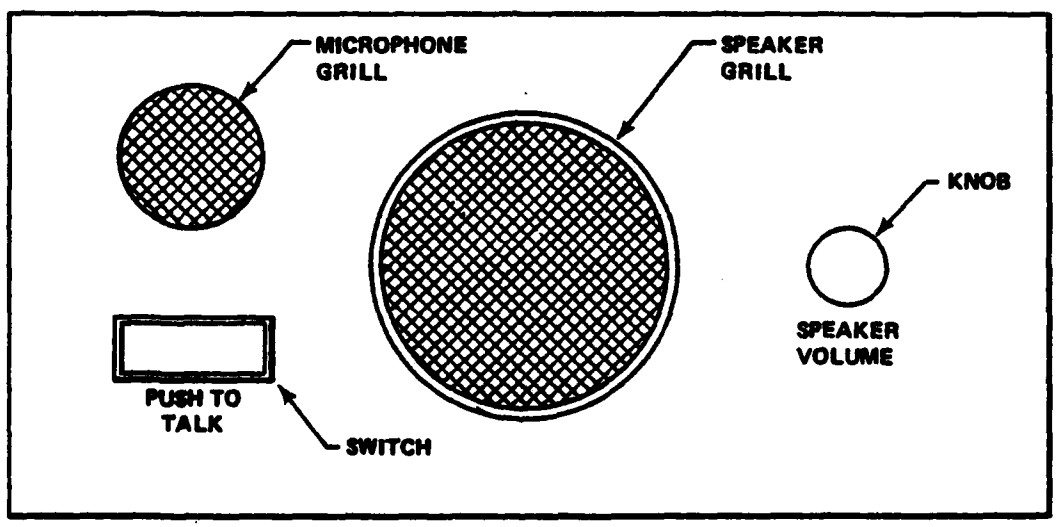
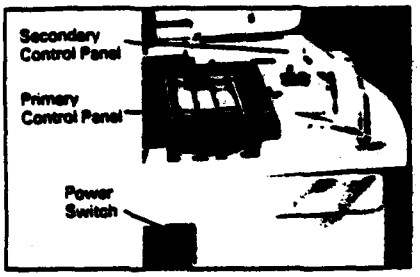


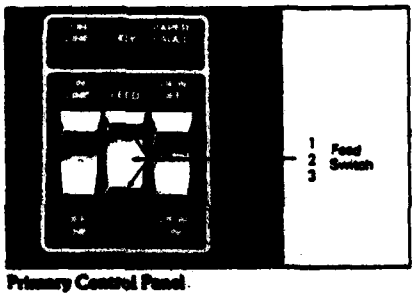
Figure 19. Instructor/Student Station Voice System

PRINTER

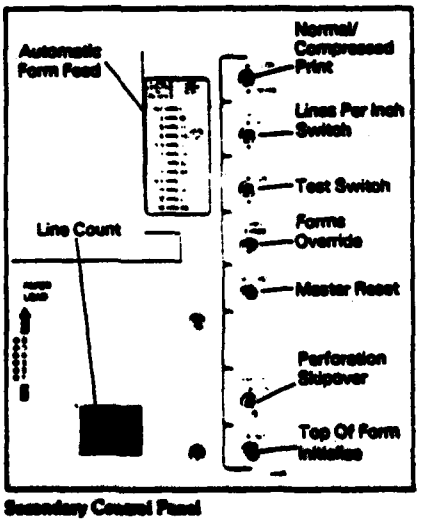
The printer will provide the instructor with hardcopy output of performance measurement results, student records and statistics. The printer is a Data General Dasher LP2 Model 6088 Data Channel Printer. Figure 20 shows the location of the operator controls (power switch, primary control panel and secondary control panel) and Table 8 describes the control and indicator functions.



Control Locations



Primary Control Panel



Secondary Control Panel

Figure 20. Instructor Station Printer Details

TABLE 8. PRINTER CONTROL AND INDICATOR FUNCTIONS

Control	Function
POWER SWITCH	This two-position switch is located on the inner side of the pedestal and operates as follows: UP/ON — The power is turned on, the fan runs, and the RDY (Ready) light glows. The printhead returns to the beginning of the line. DOWN/OFF — The power, fan, and RDY (Ready) light are turned off.
ON LINE (indicator light)	When lit, the printer is on-line (under control of the computer). When not lit, the printer is off-line.
RDY (ready indicator light)	When lit, the printer is able to accept data. When not lit, the printer is not able to accept data. The RDY light goes off when the buffer fills, or if there is a fault condition. NOTE: The RDY light will blink on and off during normal operation due to the buffer filling and emptying.
FAULT (indicator light)	A fault occurs as a result of one of a number of conditions: either the printer is out of paper, the paper has not advanced the appropriate number of lines, or the ribbon cartridge has jammed. A switch in the paper path senses the absence of paper. If the printer is out of paper, it goes OFF LINE after the first NEWLINE following the fault and the Fault light glows. The light also glows if the paper does not advance the expected number of lines. The usual cause of this is a paper jam. If the ribbon cartridge has jammed, stalling the carriage assembly, a new ribbon cartridge must be installed. In all cases, the MST RST button must be pressed following the correction of a fault condition.
ON/OFF LINE (two-position switch)	When in the ON LINE position, the printer is under the computer's control. When in the OFF LINE position, the printer is not under the computer's control. However, if a fault condition exists, the printer can be off line (RDY indicator extinguished), even though the ON/OFF LINE switch is in the ON LINE position.
FEED (three-position switch)	Pressing the switch to position 1 advances the paper one line. Position 2 is the normal position. Pressing the switch to position 3 advances the paper to the top of the next form if the automatic form feed option is installed. If the automatic form feed option is not installed, pressing the switch to position 3 advances the paper until the switch is released.
ON/OFF VIEW (two-position switch)	When in the VIEW ON position, the view feature is enabled. When in the VIEW OFF position, the view feature is disabled. When this feature is enabled and there is a pause in printing, the printhead automatically moves several spaces to the right so the last character printed can be seen. If the printhead is near the end of the line when there is a pause in printing, the printhead moves to the left instead of the right.
SECONDARY CONTROL	Various features of the printer are controlled through switches located on the secondary control panel. The printer can be controlled by these switches while the printer is off-line. When the printer is switched on-line, it retains the last switch settings. Changing the secondary panel's switch settings while the printer is on-line has no effect until the printer is switched off-line. The operation of these switches is described below:
LPI (lines per inch switch)	In the 6 position, selects 6 lines/inch spacing. In the 8 position, selects 8 lines/inch spacing.

TABLE 8. PRINTER CONTROL AND INDICATOR FUNCTIONS (CONTINUED)

Control	Function
TEST/ESCAPE DISABLE (switch)	This switch has two functions. When pressed toward TEST it is a momentary contact which initializes the self-test sequence. When pressed toward ESCAPE DISABLE the switch remains in place. In this mode the printer disregards all "escape" characters (033 octal) which appear in the incoming data, and interprets the succeeding character normally. To SELF-TEST the printer, proceed as follows: 1. Depress MST RST. 2. Switch the printer OFF-LINE. 3. Press the TEST/ESCAPE DISABLE switch toward TEST and release it. 4. Adjust the remaining switches on the Secondary Control Panel for the functions to be tested (COMP/NORM, LPI, CHAR SET, PERF SKIP, and LINE COUNT). 5. Switch the printer ON-LINE. To stop the SELF-TEST sequence press MST RST.
FORMS OVERRIDE (pushbutton switch)	Depressing this switch, after running out of paper, allows printing to the end of the form. This switch is handy if paper runs out when in the middle of a job.
MST RST (Master Reset pushbutton)	Depressing this switch initializes (sets up) the printer according to the switch settings of the primary and secondary control panels.
PERF SKIP (Perforation Skip-over switch)	When in the ON position, the printer skips an inch between forms (the perforation). When in the OFF position, the printer does not skip any space between forms.
AUTOMATIC FORM FEED	With this option the printhead can be returned to the beginning of the line and advance the paper to the top of the next form all in one operation. The DASHER LP2 can perform a form feed on forms up to 16.5 inches long. Before using automatic form feed, set the form feed controls located on the secondary control panel. These controls include the TOFINIT (Top of Form initialize) switch and the LINE COUNT switches. Set these switches as follows: 1. Switch the printer OFF Line. 2. Advance the paper manually or by pressing the Line Feed switch to the line to be initialized as the top of the form. 3. Set the line countwheels to the total number of lines between perforations on the form being used. If the Lines Per Inch switch is set for 6, use the chart on the secondary panel to convert from form length to line count. If it is set for 8 lines per inch, the number of lines equals 8 multiplied by the form length (inches). Thus, the maximum form length is 12.4 inches for 8 lines/inch and 16.5 inches for 6 lines per inch. 4. Press and release the TOFINIT pushbutton. 5. Switch the printer on line. Now this option can be utilized. To carry out a form feed operation, press the three-position switch on the primary control panel to FORM FEED. Each time the length of the form is changed, or the setting of the LPI (Lines Per Inch) switch is changed, the procedure must be repeated.

CONSOLE

The instructor station console is a Data General Dasher CRT display terminal. Refer to Figure 16 and Table 5 for a description of the display controls. The keyboard for this terminal contains special training system specific keys. Figure 21 shows the location of these keys, and Table 9 describes their functions.

Unless otherwise noted, all special-fuction keys act in the following manner. When a key is pressed, the title of the function that it calls appears in a single command line on the terminals CRT. The contents of the command line are not acted upon by the ACE system until ENTER (NEXT/ENTER) is pressed; until that is done the blinking cursor follows the last character in the command line to indicate that the command has not been accepted (and to indicate where the next character in the command line would be placed if another key were pressed). If an invalid (i.e., not currently functional) special-function key is pressed, "INVALID ACTION" appears in the command line, and the entire command line is rejected by ACE when "ENTER" is pressed.

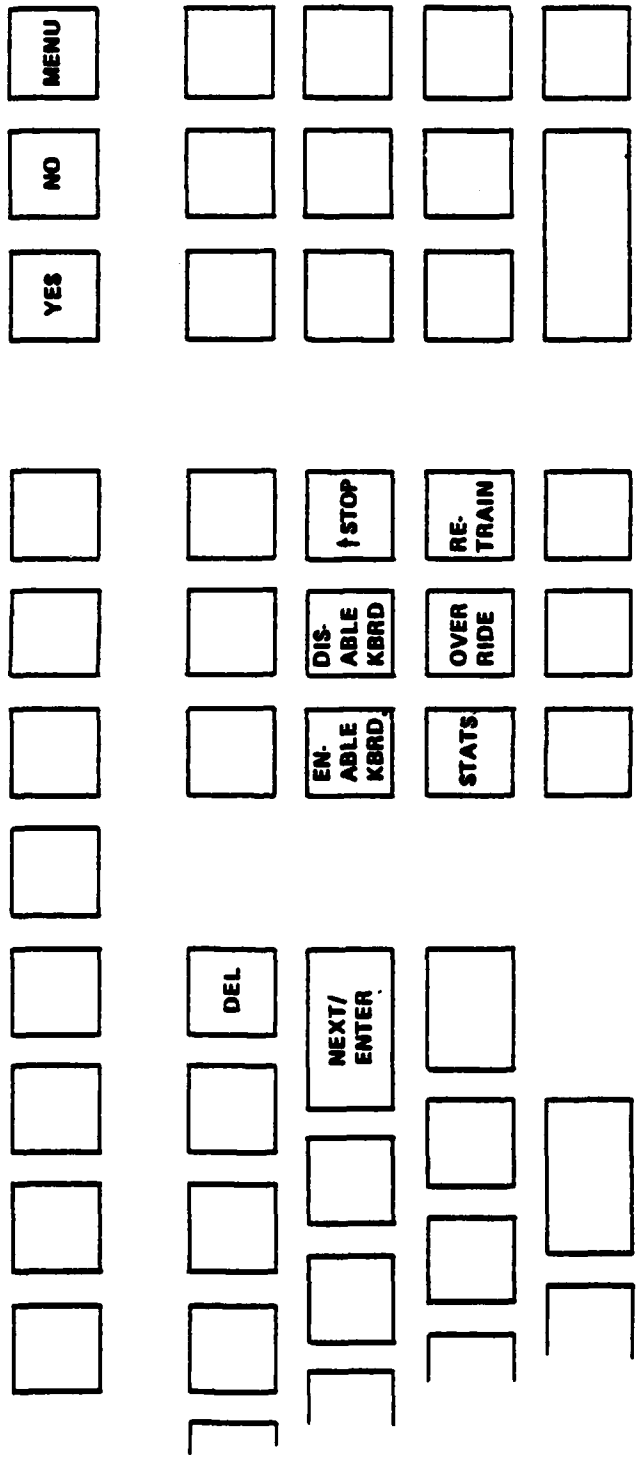


Figure 21. Instructor Station Keyboard

TABLE 9. INSTRUCTOR CONSOLE KEYBOARD FUNCTIONS

Key	Function
DEL	Contrary to the normal function of this key on the Dasher terminal (to delete single characters), the DEL key deletes the entire command line.
NEXT/ENTER	NEXT/ENTER appears to have two functions to the user of the terminal. The "NEXT" function serves to call up the next page of a sequence of text pages replaced by the MENU display. The "ENTER" function causes the command input line to be transmitted to the ACE system. Commands in the command line do not take effect until the NEXT/ENTER key has been pressed. The action of the NEXT/ENTER key is immediate. This key replaces the NEW LINE key on the Dasher terminal.
YES NO	These special-function keys cause "YES" and "NO" to appear in the command line. They are used to input answers to questions posed by ACE.
MENU	This key causes a list of the currently available special functions to be displayed on the CRT of the terminal at which it was pressed. The MENU display does not appear on the other terminal's CRT. The MENU display persists until the CRT display "page" is changed for both terminals by ACE (replacing the current page of text with the next page of text), or until the NEXT key is pressed at the terminal displaying the menu (in which case the previous page display will be restored to the CRT). If a question or prompt is on the CRT, the MENU display will not appear until after a response has been entered.
ENABLE KBRD	ENABLE KBRD allows the instructor to activate the instructor key subset on the student keyboard. Additionally, any CRT text that normally would be sent only to the instructor station CRT will be sent to both CRTs when this function is operating.
DISABLE KBRD	DISABLE KBRD deactivates the instructor key subset on the student station keyboard.
STOP	This key is used to terminate the ACE program and make the system ready for power-down. The function is invoked using the SHIFT key (hence the "↑"in the title). If a student is using the other terminal, the system will notify the instructor after ↑STOP has been entered; the instructor will be asked to confirm the command for immediate execution, to confirm it for execution when the student has completed the current segment (if a student is on the system), or to rescind the command.
STATS	This key will cause a menu to appear on the instructor's CRT, from which he may select displays or printouts of statistical data pertaining to the individual student, the class, or the syllabus. The student is not disturbed when this function is accessed. The student has available a similar function (which is limited to his own statistics) which he may select from the ABORT menu.
OVERRIDE	This function key allows the instructor to overrule ACE's placement of the student within the syllabus. An override menu will appear on the CRT that will contain such options as to advance the trainee to the next scheduled segment, or to take him back to any previously-encountered segment. If a previous segment is selected, the trainee will return to his former (pre-OVERRIDE) position in the syllabus after he completes the selected segment. The student's activity will not be affected until after the selection of an override menu option, and in some cases not before the normal end of the current segment.
RETRAIN	RETRAIN causes a special speech data collection program to be scheduled for sometime after the current segment. The program will serve to collect speech reference patterns for a previously-trained phrase. The instructor selects the phrase and the number of times it is to be given the options to collect more data, enter the speech validation program, modify the student's error file for rescoring purposes, or continue in the syllabus.

SECTION IV

STUDENT STATION

OVERVIEW

The student station equipment consists of a Dasher CRT display terminal with special function keys for scenario and training control; an audiovisual system containing a videodisc and color TV monitor; speech recognition equipment containing a speech recognition device and a headset with two independent earphones and a microphone; and the Training Enhancement Console, which is a mockup of an OA-7979(V)10/ UYA-4(V) NTDS console.

CONSOLE

The student station console is a Data General Dasher CRT display terminal. Refer to Figure 16 and Table 5 for a description of the display controls. The keyboard for this terminal contains special training system specific keys. Figure 22 shows the location of the keys, and Table 10 describes their functions.

Unless otherwise noted, all special-function keys act in the following manner. When a key is pressed, the title of the function that it calls appears in a single command line on the terminal's CRT. The contents of the command line are not acted upon by the ACE system until ENTER (NEXT/ENTER) is pressed; until that is done the blinking cursor follows the last character in the command line to indicate that the command has not been accepted (and to indicate where the next character in the command line would be placed if another key were pressed). If an invalid (i.e., not currently functional) special-function key is pressed, "INVALID ACTION" appears in the command line, and the entire command line is rejected by ACE when "ENTER" is pressed.

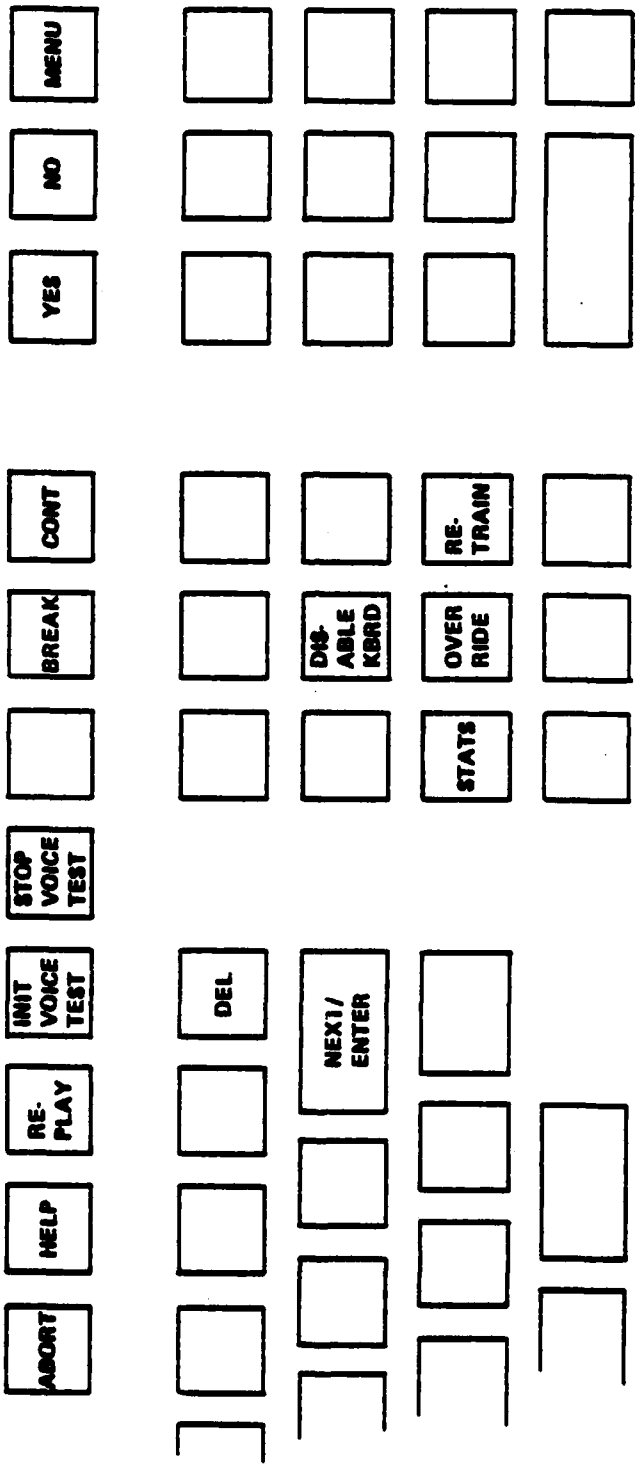


Figure 22. Student Station Keyboard

TABLE 10. STUDENT CONSOLE KEYBOARD FUNCTIONS

Key	Function
DEL	Contrary to the normal function of this key on the Dasher terminal (to delete single characters), the DEL key deletes the entire command line.
NEXT/ENTER	NEXT/ENTER appears to have two functions to the user of the terminal. The "NEXT" function serves to call up the next page of a sequence of text pages replaced by the MENU display. The "ENTER" function causes the command input line to be transmitted to the ACE system. Commands in the command line do not take effect until the NEXT/ENTER key has been pressed. The action of the NEXT/ENTER key is immediate. This key replaces the NEW LINE key on the Dasher terminal.
YES NO	These special-function keys cause "YES" and "NO" to appear in the command line. They are used to input answers to questions posed by ACE.
MENU	This key causes a list of the currently available special functions to be displayed on the CRT of the terminal at which it was pressed. The MENU display does not appear on the other terminal's CRT. The MENU display persists until the CRT display "page" is changed for both terminals by ACE (replacing the current page of text with the next page of text), or until the NEXT key is pressed at the terminal displaying the menu (in which case the previous page display will be resorted to the CRT). If a question or prompt is on the CRT, the MENU display will not appear until after a response has been entered.
DISABLE KBRD	DISABLE KBRD deactivates the instructor key subset on the student station keyboard. Active only when instructor keys are active.
STATS	This key will cause a menu to appear on the CRT, from which the instructor may select displays or printouts of statistical data pertaining to the individual student, the class, or the syllabus. The student has available a similar function (which is limited to his own statistics) which he may select from the ABORT menu. Active only when instructor keys are active.
OVERRIDE	This function key allows the instructor to over-rule ACE's placement of the student within the syllabus. An override menu will appear on the CRT that will contain such options as to advance the trainee to the next scheduled segment, or to take him back to any previously-encountered segment. If a previous segment is selected, the trainee will return to his former (pre-OVERRIDE) position in the syllabus after he completes the selected segment. The student's activity will not be affected until after the selection of an override menu option, and in some cases not before the normal end of the current segment. Active only when instuctor keys are active.
RETRAIN	RETRAIN causes a special speech data collection program to be scheduled for some time after the current segment. The program will serve to collect speech reference patterns for a previously-trained phrase. The instructor selects the phrase and the number of times it is to be given the options to collect more data, enter the speech validation program, modify the student's error file for rescoring purposes, or continue in the syllabus. Active only when instructor keys are active.
ABORT	This key aborts the execution of any segment. After an ABORT the student's position within the syllabus will be at the beginning of the current normally scheduled segment. After an ABORT has been entered, a special ABORT menu will appear, from which the terminal user may select the following options: review, continue instruction, sign off, display statistics.

TABLE 10. STUDENT CONSOLE KEYBOARD FUNCTIONS (CONTINUED)

Key	Function
HELP	This key is used by the student to signal to the instructor that his assistance is needed. A message such as "<student's name> HAS REQUESTED INSTRUCTOR'S ASSISTANCE — <time>" will appear on the instructor station CRT, heralded by a "beep" (CONTROL-G) from the terminal. It also will cause the instruction or exercise to "freeze" (see the discussion of the BREAK key).
REPLAY	This key is used to command ACE to schedule a special replay to follow after completion of the current segment or scenario. This segment will consist of a "pure" replay (i.e., one without external inputs) at the TEC of the student's most recent Free Practice exercise. It will be possible to "freeze" this replay. (See BREAK). At the conclusion of the replay, ACE will prompt the user to determine whether to continue instruction or go through the replay again.
INIT VOICE TEST	INIT VOICE TEST causes ACE to schedule a special speech validation program for execution sometime after the current segment. During voice validation, the accuracy of ACE's phrase recognition will be tested by the system echoing the student's spoken words.
STOP VOICE TEST	STOP VOICE TEST terminates the speech validation program.
BREAK	This key is used to suspend the action of the ACE system. It may be used by the student or instructor to force a pause during any segment. (The BREAK specialfunction key has no similarity in action to the BREAK key on an unmodified Dasher terminal — although the same keytop will be used.)
CONT	This key is used to cancel the action of the BREAK key. Normal ACE execution resumes.

AUDIO/VISUAL SYSTEM

This system consists of a videodisc player and a color TV monitor. The color TV monitor is located above the student console on the student station table. The videodisc player is located on the right side of the student station table. Operator interaction with the player consists of changing the videodisc. All other functions of the player are under computer control.

SPEECH RECOGNITION SYSTEM

This system is housed in the equipment bay next to the student station table. All functions of this equipment are computer controlled.

TRAINING ENHANCEMENT CONSOLE (TEC)

The training enhancement console is a mockup of an OA-7979(V)10/ UYA-4(V) NTDS console. The following paragraphs describe the function of all controls and indicators available on the console. Refer to Figures 9 and 10 for the general layout of all panels described.

DRO. The Data Readout is located in the upper left of the TEC. A black and white CRT monitor is used and will display readouts in the same format as the left-most 36 projection displays existing on the OA-7979(V)10.

INSTRUCTION CRT. This black and white CRT monitor is located in the upper-right of the TEC. It replaces the right-half of the 72 projection displays in the OA-7979(V)10 and will be used to display alphanumeric data for instructional purposes.

CATEGORY SELECT AND COMMUNICATIONS PANEL. This panel is located to the left of the PPI. The top section contains the category select switches. These switches are not functional. The bottom section contains all the communications controls. Figure 23 shows the location of the controls and indicators on this panel. Table 11 describes the function of these controls.

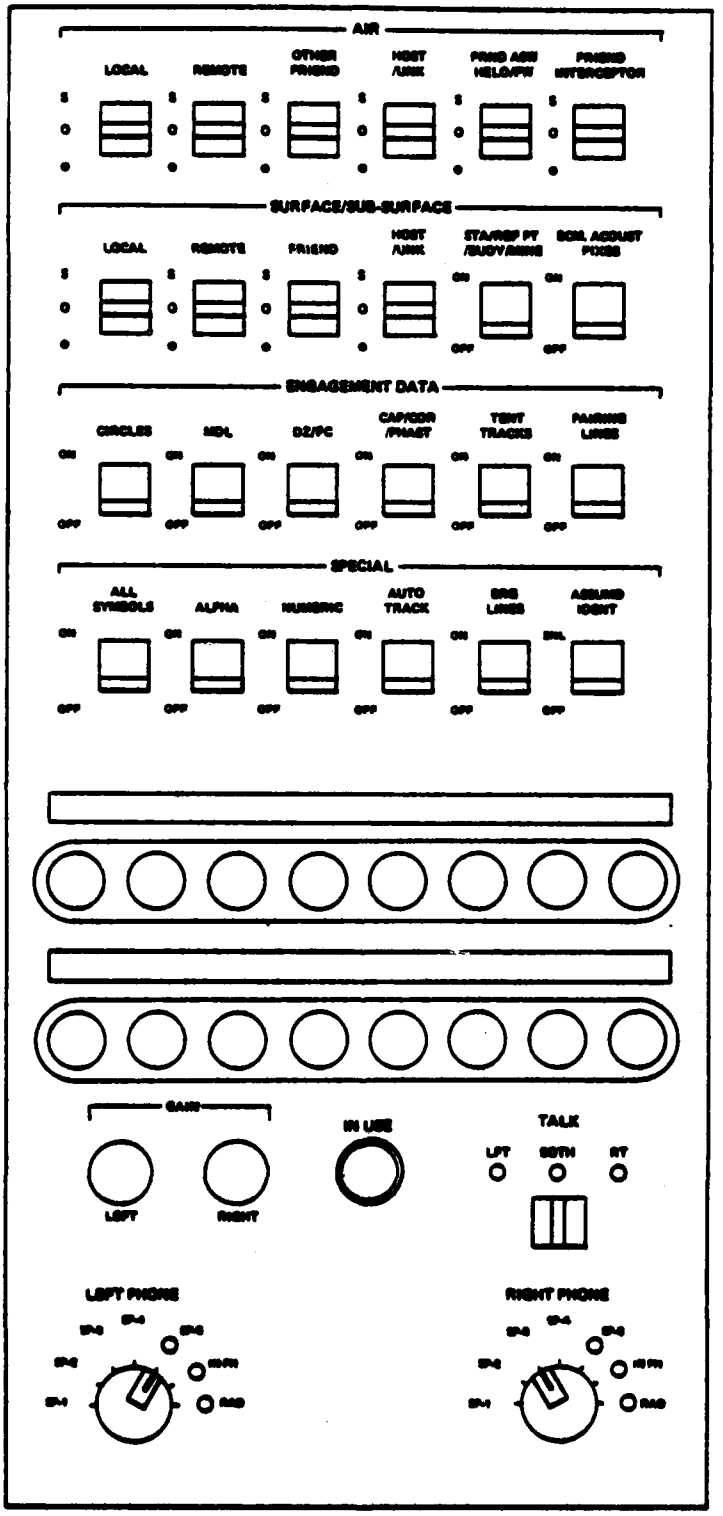


Figure 23. TEC Category Select/Communications Panel

TABLE 11. COMMUNICATIONS PANEL CONTROL FUNCTIONS

Control	Function
POINT switch	This momentary switch causes a pointer symbol to be displayed at the ball tab coordinates as long as the button is depressed. The key cap is lightable under program control for instructional purposes.
SWC switch	This alternate action switch, in conjunction with the TALK and PHONE switches, control communication with the SWC Model in the same manner as the OA-7979.
	The remaining 14 unlabled communications switches are inactive.
TALK switch	This three position switch in conjunction with the PHONE switches, determines the destination of the student's voice in the same manner as the OA-7979.
LEFT/RIGHT PHONE switches	These seven position switches determine the audio source for the left and right earphones. INPH (inter-console phone) and RAD (radio) are the only active positions. SP-1 thru SP-5 are dead-air positions.
LEFT/RIGHT GAIN potentiometers	These potentiometers are volume controls for the audio heard in the left and right earphones.
IN USE light	The radio-in-use light is lit when the radio transmitter is being used by the student.
LEDS	The LEDs associated with the TALK and PHONE switch positions are used as pointers for instructional purposes.

PLOTTING HEAD. The plotting head used on the TEC is an actual plotting head from an OA-7979 and thus is identical in operation. Controls included are panel dim, drop track, enter mode and radar, and the true bearing indicator.

RADAR DISPLAY. Simulated radar and NTDS symbology are displayed on the vector graphics monitor located behind the plotting head.

DISPLAY CONTROL PANEL. This panel is located to the right of the PPI. Figure 24 shows the location of the controls and indicators. Table 12 describes the function of all active controls. Inactive controls are ASTIG (astigmatism), N.S./E.W. (centering), SIF/IFF CHALLENGE and GATE (and indicators) and ADJ LEADERS.

TABLE 12. DISPLAY CONTROL PANEL CONTROL FUNCTIONS

Control	Function
BRIGHTNESS CONTROLS	These four potentiometers control the brightness of the respective displays on the PPI.
FOCUS	This potentiometer controls the focus of the PPI.
CRT CENTER	This two position switch determines what point is displayed at the center of the PPI and operates as the like control on the OA-7979.
ENTER OFFSET	This momentary pushbutton switch enters the offset point as the position of the ball tab coordinates. The key cap is also lightable under program control to act as a pointer for instructional purposes.
VIDEO	This five position switch is used to select the video desired for the selected radar. Position 1 is the only active position. The other four positions will result in no video being displayed.
RADAR	This twelve position switch is used to select the desired radar. Position 5 is the only active position. The other eleven positions will result in no radar display.
RANGE	This ten position switch is used to select the radius in miles to be displayed on the PPI. Positions 16, 32 and 64 are the only active positions. Selecting ranges 1, 2, 4 or 8 will result in the 16 mile range being displayed. Selecting ranges 128, 256 or 512 will result in the 64 miles range being displayed.
STD LEADERS	This three position switch is used to select standard leaders. The only active position is AIR. Selecting SEA results in no leaders being displayed.
LEDs	The LEDs associated with the switches shown are used as pointers for instructional purposes.

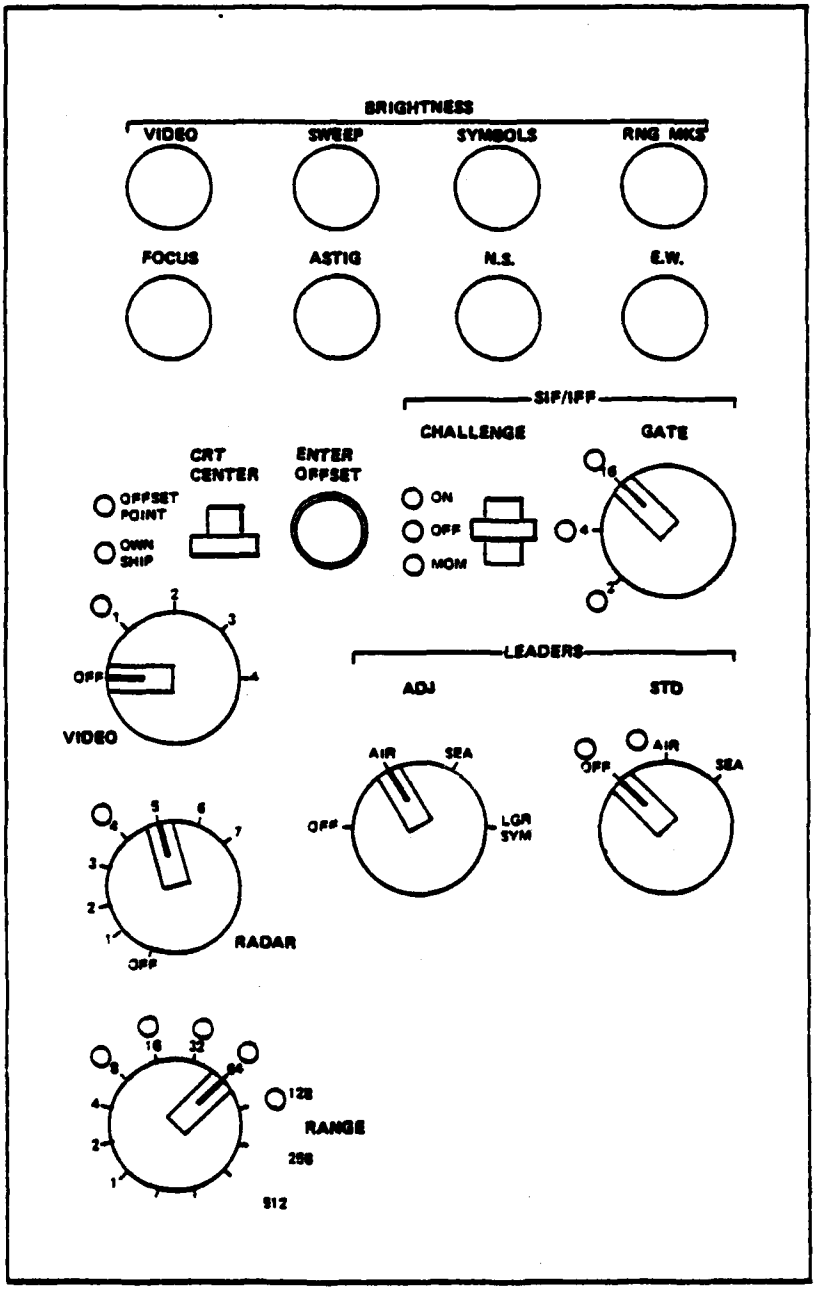


Figure 24. TEC Display Control Panel

TRACK BALL PANEL. The track ball panel is located in a well below the display control panel and is functionally identical to the OA-7979 track ball panel. Figure 25 shows the location of the controls on this panel. The four momentary action pushbutton switches in the panel perform the same function as those on the OA-7979. In addition, each switch cap is labeled and lightable under program control for instructional purposes.

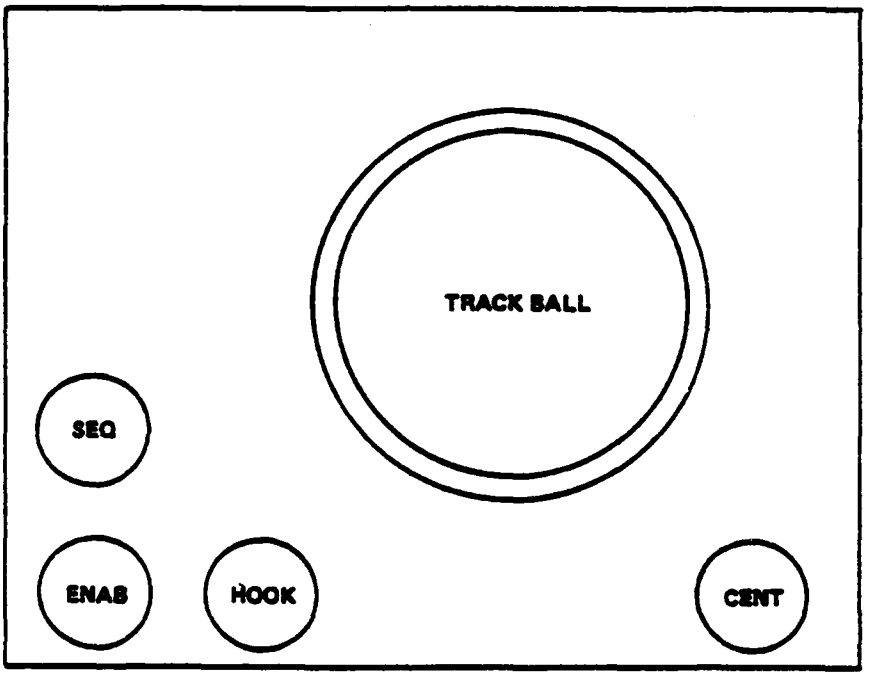


Figure 25. TEC Track Ball Panel

VARIABLE ACTION BUTTON PANEL. This panel is located at the left side of the bullnose. Figure 26 shows the location of the controls and indicators. The panel has no mode roller as in the OA-7979. All mode, alert and VAB labels are fixed in the AC mode as shown in SOM(P)-6400, Volume 2, Model 4, Phase 0.1, Section IV-F. All alert labels and the function labels above each momentary pushbutton switch are individually lightable to function as pointers for instructional purposes.

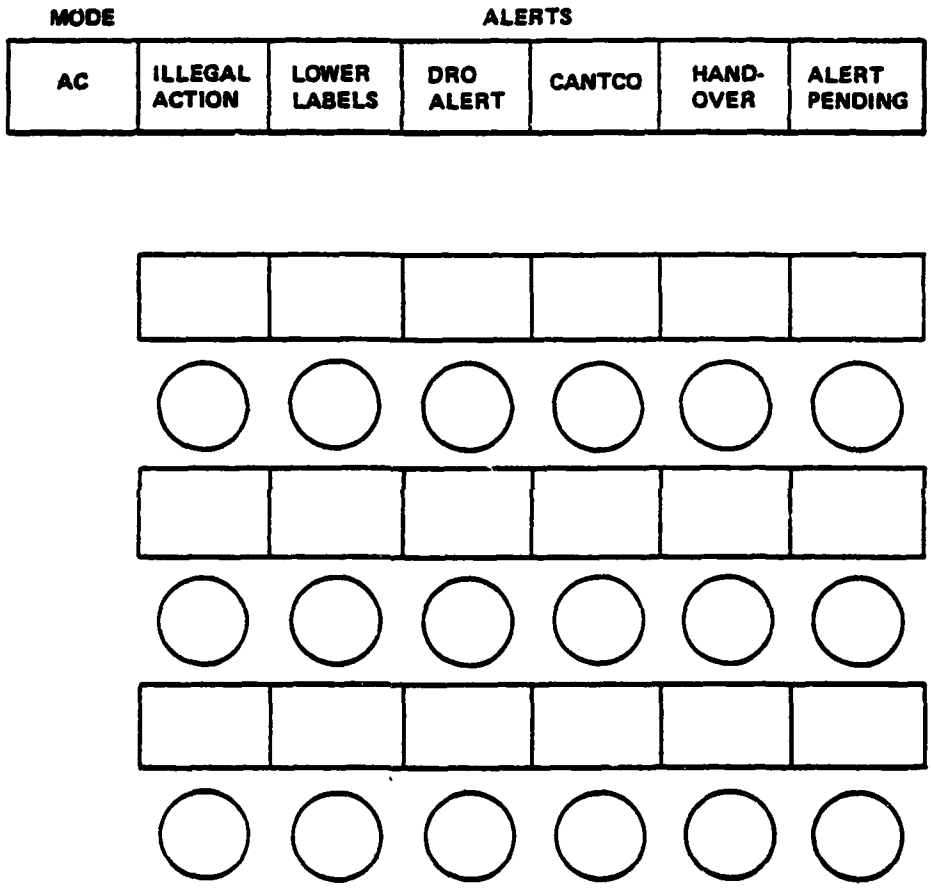


Figure 26. TEC Variable Action Button (VAB) Panel

NUMBER ENTRY PANEL. This panel is located in the center of the bullnose. Figure 27 shows the position of the controls and indicators. The panel is identical in operation to the panel in the OA-7979. In addition the five function pushbuttons have lightable keycaps to serve as pointers for instructional purposes.

LOWER FRONT PANEL. The lower front panel under the bullnose houses the main power switch and the communications footswitch.

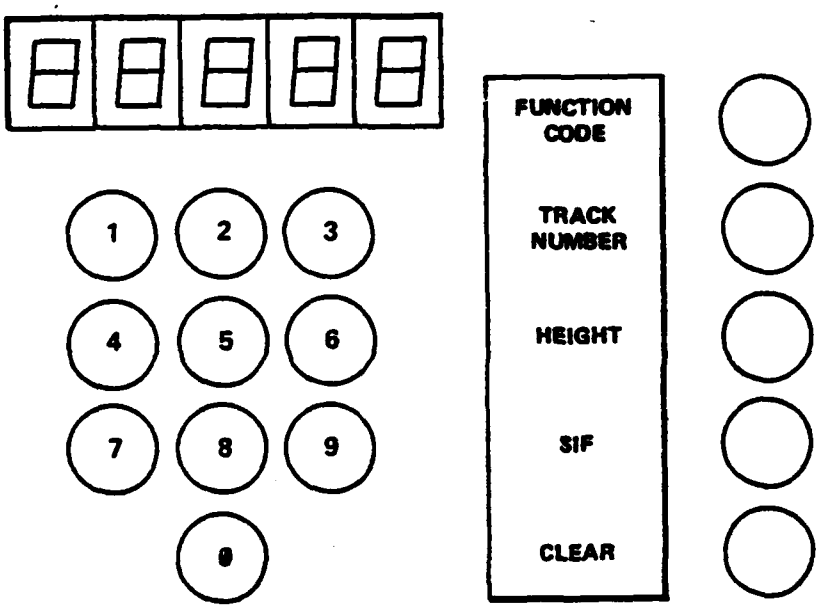


Figure 27. TEC Number Entry Panel

SECTION V

MAINTAINABILITY CONSIDERATIONS

Logicon will provide on-site, on-call maintenance of the system. Preliminary analysis of any problem will be performed by Logicon engineers. Malfunctions specific to Data General equipments will be repaired on-site by Data General field service under contract. Malfunctions specific to VOTRAX, Megatek, videodisc, color TV monitor or speech recognition equipments will be repaired by factory service under contract with minimal downtime. All other off-the-shelf hardware, Logicon manufactured hardware and Logicon software will be maintained by Logicon personnel.

The floor plans shown in Section I provide adequate maintenance accessability for all systems.

The systems in the computer suite are accessed for maintenance from the front of the cabinets. All elements except the Votrax are slide mounted for ease of access; the Votrax is a lightweight unit which is easily removed from the cabinet. The Megatek display system has a built-in test feature which is activated from the rear of the unit. All other units are tested by disk-based diagnostics. Diagnostics for the Data General equipment also may be loaded by Data General field service personnel using a portable tape cassette unit.

The elements of the instructor station are freestanding terminal-like devices. The three CRT terminals are accessed from the front for maintenance purposes. These terminals have an off-line mode of operation in which diagnostic work may be performed; they also may be exercised from the CPU to which they are attached. Maintenance access to the line printer requires that it be moved so the cover on the right side of the pedistal can be removed. The lineprinter has a built-in self test which is controlled by switches located at the right side, under the top cover.

Many diverse elements have been assembled to construct the student station. Access to all sections of the TEC is gained through the rear of the cabinet. The Micro Nova is tested by downline loading the test programs from CPU2 of the computer suite. Simple testing may be performed using the hand-held console which comes with the Micro Nova. The panel logic and panel hardware may be tested with programs downline loaded to the Micro Nova. There is also built in test equipment for the panel logic which allows stand alone testing. The display monitor in the TEC is tested by the built in test programs of the display controller located in the computer suite; an intercomm is provided for communications between the computer suite and the student station. The videodisc system is mounted on top of the table for easy access. The system operates in stand alone mode for testing. The voice recognition system will be accessed from the rear of its cabinet. This system will be tested in stand alone mode and by exercise programs from CPU3 of the computer suite. The Dasher terminal is accessed and tested in the same manner as the other Dasher terminals in the instructor station. The student terminal will be tested from CPU1 of the computer suite.

Periodic maintenance will consist of diagnostic checks of all systems once a month, replacement and/or cleaning of filters every three months, and inspection of items subject to heavy wear every six months. Any of these periodic maintenance items will require not more than two hours of system down time and will be performed on a mutually agreeable schedule.

SECTION VI

HUMAN FACTORS CONSIDERATIONS

One of the primary design goals of the ACE project is to keep the system simple and comfortable for the experimenters, instructors, and, especially, the students to access and use. This user orientation is reflected in many areas of the prototype design.

The training system is divided into basically two parts: (1) the computer suite and instructor station and (2) the student station. Except for power up, power down, and disk loading, the computer suite is not "visible" to the system users. Therefore, the human factors considerations (HFC) are limited to strategically placed instructions on the hardware and carefully worded procedures supplied in the instructor handbook.

The HFC for the instructor station are more broadly based. The dasher terminal keyboard has been modified to supply specially designated function keys (see figure 21) to allow entire procedures to be initiated with a two-stroke entry (1. special function key, 2. next/enter). It should be noted that the student station keyboard also has instructor oriented special function keys. There is a microphone and speaker built into the instructor station to allow student/instructor interaction without pulling the instructor away from the instructor station. The speaker also can be used to monitor student verbalizations during instructional sequences.

A printer is also supplied at the instructor station to supply hard copy printouts of student performance summaries for the instructors and various statistical printouts for instructors and experimenters.

The HFC at the student station are quite extensive. The student station can be divided into the instructional area and the training enhancement console (TEC).

INSTRUCTIONAL AREA

The instructional area consists of a terminal, an audio visual (AV) presentation system, a microphone/speaker unit, and a work area. Each of these has associated HFC.

The HFC for the terminal include both the CRT and the keyboard. HFC for the CRT include the use of two different brightnesses and blinking for character displays to act as visual pointers (highlighters). Additionally, a blinking character is used to show the present position of the cursor. HFC for the keyboard include the use of a special key arrangement. Keys have been carefully specified in terms of (1) placement, (2) size, (3) colors, and (4) titles to simplify and enhance the students' use of the terminal keyboard (see figure 22). Additionally, only the "next/enter" and the "delete" keys have been designated as "single-stroke" keys. Strokes on all other keys must be followed by a stroke on "next/enter" before they will be acted upon. This arrangement allows the learner to change the input ("delete") if he has made a mistake or changes his mind.

The AV presentation system has been chosen because it allows rapid access to materials, a large storage capacity which minimizes student hardware interaction, motion displays, color, and high quality sound reproduction. The Proposal for a Videodisc Player Enhancement for Air Intercept Controller Training System (May 23, 1979) listed several factors involved in the choice of the videodisc as the medium for AV presentations. Those factors are excerpted below:

> Three major factors are operating in ACE development to determine audio/visual requirements. One factor determining the A/V support requirements is the fact that the ACE courseware will present several different kinds of learning tasks. AIC trainees will be asked to learn both cognitive and psychomotor skills for using a variety of equipment to provide required information about a constantly changing situation. The trainees will also be presented A/V information about accomplishing those skills on different versions of those pieces of equipment.
>
> Teaching these particular knowledges and skills will require A/V support materials such as photography or film to show procedures, demonstrations, or comparisons between different versions of equipment; graphics to provide simplified or emphasized representations; and titles for testing, job aids or memory aids. This support will be provided for the over 200 instructional segments which will comprise the AIC curriculum, meaning that perhaps as many as thousands of audio/visual frames (it could be 10,000 – 15,000 if film is used) will be required.
>
> Another factor affecting A/V support requirements is the structure of the learning environment. In this system, one design goal is that all instruction be provided in an automated stand-alone environment. Strictly interpreted, this means that the learner and human instructor should not have to be actively involved in making the system work. This includes being required to load and unload A/V modules from the equipment. Thus, the A/V presentation system should be able to store all the audio/visual frames for continuous access without human assistance.
>
> A third factor affecting the requirements for A/V support is the instructor model driving the training curriculum. In the ACE system there has been careful design work done to provide adaptive training. This means the training system has both learner control and system control features which result in a "customized" syllabus for each learner. Both the learner and the system have some control over the pace, the content, and the order which the training system presents.
>
> What an adaptive training model means to A/V support is that the A/V materials may be used differently by each learner. The learner may skip some areas entirely while having to repeat other materials a

number of times. To meet the needs of adaptive training, the A/V presentation system must be able to access any of its materials at any time or skip over materials selectively.

In summary, the A/V presentation system requirements listed suggest that, optimally for ACE, we need a very flexible, high density storage system. The system should be able to store and access each of over 1000 frames of A/V material for presentation in any order at any time. Automated slide/tape based systems cannot meet all of those requirements, but a videodisc player based system can....

...benefits include the system's ability to show normal motion, slow motion, and reverse motion. There are many psychomotor skills and affective objectives for which normal motion, slow motion, or reverse motion can enhance training effectiveness. A final benefit is the capacity to provide two different tracks of audio for each video sequence. Thus, if you want to use the same sequence for instruction one time and remediation or review another time, you can present the same pictures with different words.

The placement of the video display was a factor. It has been decided to mount the AV display above the terminal display. This arrangement minimizes the amount of student turning and movement from the terminal while, at the same time, removing the distraction of having the AV display in the field of peripheral vision. This arrangement of terminal and video display has the added side benefit of providing the student with an open work area beside the terminal/AV module.

TRAINING ENHANCEMENT CONSOLE (TEC)

The initial human factors decision involving the TEC concerned what the TEC should look like. The choice was made to simulate the DA-7979(V)10/UYA-4(V) in order to give the student the feeling that he is working with a real, and possibly familiar, piece of NTDS equipment.

Each of the specific areas of the NTDS look-alike console had human factors considerations associated with them. In order to make the graphics display look as real as possible, a Megatek graphics display unit was purchased which is capable of simulating the radar sweep and which is the same size as the radar display. Additionally, the Megatek was specified with the same phosphor used in NTDS displays and a real plotting head will be utilized. Finally, the normal NTDS symbols will be used on the display during simulated runs.

The student headset and microphone al have been a human factors focus. The headset to be used will be chosen for optimum comfort to allow longer work periods without discomfort or fatigue. The headset also will have double ear plugs to provide a realistic "split" headphone simulation. The microphone is to be carefully chosen to optimize speech recognition with whichever speech recognition system is chosen. This optimization probably will be accomplished by choosing a realistically sized microphone which minimizes the collection of extraneous noise.